A MONOGRAPH OF THE SATURNIAN SUBFAMILY LUDIINAE.

By DR. KARL JORDAN.

(With Plates 1 and 2, and text-figs. 1–169.)

AFTER the publication of the *Revision of the American Papilios* in 1906 we took up the study of the superfamily *Saturnioideae* with a view to issuing an account of the morphology and classification of the Lepidoptera united under that name. Various circumstances delayed progress, and when we heard from Dr. Packard that he was working intrinsically at the same group of moths and would publish a monograph of them, we were glad to postpone the continuance of our own investigations, as we did not wish to anticipate Dr. Packard in any way. Unfortunately for science, Dr. Packard died before he had completed his researches on the *Saturnioideae*. His manuscript was left incomplete and lacked the final revise by its author. However, it has been ably collated by Professor Cockerell and has appeared as a posthumous work in 1914, a volume splendidly got up and full of information. Since the termination of the war we have again devoted some attention to the Saturnians as time and circumstances permitted.

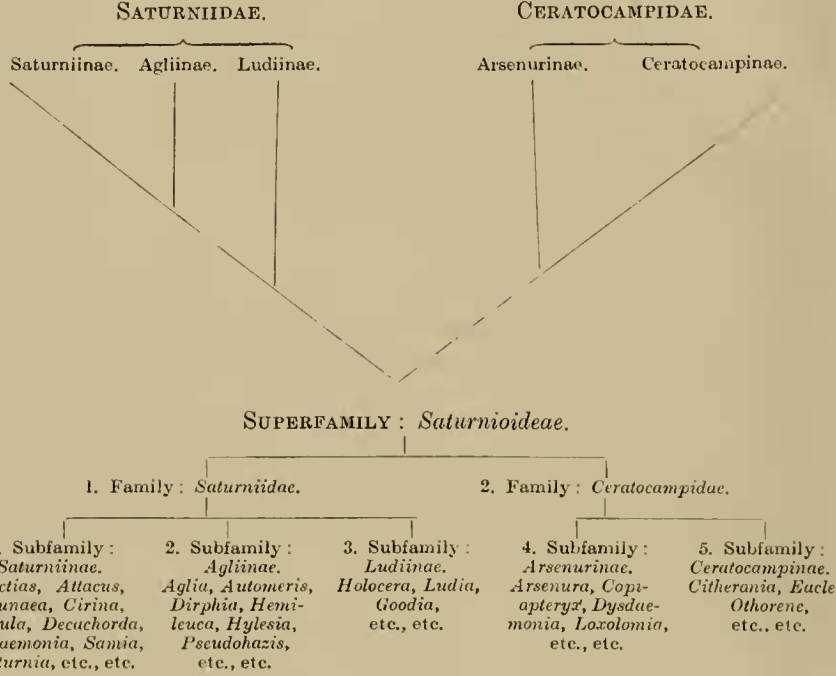
It seems desirable for several reasons that we publish our account in instalments. And in adopting this procedure, we venture to express the hope that Lepidopterists who are in possession of material we have not been able to consult, or who have knowledge of important facts with which we are not acquainted, will complement and correct our account, and thereby render the issue of a comprehensive revision of the whole superfamily, contemplated for the future, more complete and useful.

Although the Saturnians are large insects, they are by no means an easy group to study. The great size of the wings and the woolliness of the body are frequently serious obstructions, if the specimens are unique. But even if large numbers of specimens are available, one meets often with great difficulties in the discrimination of the species, and in diving below the superficial, elements of uncertainty are frequently encountered which are almost discouraging.

We have been greatly assisted in our task by the generous loan of specimens on the part of various museums and private collectors, and we wish to tender our thanks in particular to Professor E. B. Poulton, Mr. J. J. Joicey, Oberst-Lt. Richelmann, Mr. H. J. Watson, and our colleagues at the British Museum, Paris Museum, and the Berlin University Museum for the help they have given us.

It is not our intention to present a general account of the superfamily now. That is better postponed till we have dealt in detail with the various groups that belong here. But in order to make ourselves more easily understood, we

deem it neeessary to say a few words about the classifieation within the superfamily. The following diagram represents our view:



The *Ceratocampidae* * have a large parasternum † in the mesosternite, and comprise the large-winged *Arsenurinae* and the (broadly speaking) small-winged *Ceratocampinae*. The family is entirely confined to the American Continents. All the larvae have lost the faculty of spinning a cocoon.

In the *Saturniidae*, with the exception of most *Ludiinae*, the parasternum of the mesosternite is small as compared with the episternum.

In the *Saturniinae* the antennae have nearly always multiple sensory cones at least on the most distal segments (the cones vestigial in *Eudia spini*, e.g.), and if the antennae are quadripectinate, the apical and proximal branches of consecutive segments are separated by a gap at their bases, with the exception of a few aberrant forms. Cross-vein D^1 of forewing long, D^2 directed basad, rarely absent. This subfamily comprises all the Old-World Saturnians, with the exception of *Aglia* (Palaearctic) and the *Ludiinae* (African), and also includes a number of American genera, which are more numerous in the Nearctic Region than in the Southern Continent. Cocoon spinners, with the exception of a large African section which has lost the faculty of spinning.

The *Agliinae* have a single apical sensory cone in all antennae, at least on the most distal segments, and in the case of quadripectinate antennae the apical

* Sir George Hampson, Bart., in Nov. Zool. xxv. p. 389 (1918), distinguishes the *Saturniidae* (= *Attacidae*) from the *Ceratocampidae* (= *Sysphingidae*) by the absence of the proboscis and of the tibial spurs. A very significant error of observation.

† For the nomenclature of the sclerites of the mesosternite cf. Jordan, "Das Mesosternit der Tagfalter," in *Verhandl. Internat. Zool. Congress*, 1901, pp. 816 ff. (1902).

and proximal branches of consecutive segments are contiguous at their bases. Cross-vein D^1 of forewing short or absent. An American subfamily which is represented in the Old World by one genus only, *Aglia*. Pupa in a cocoon.

The *Ludiinae* are an early offshoot with many specialisations, approaching the *Ceratocampidae* in the structure of the mesosternite (text-fig. 1, *Ludia*), and combining to some extent the Saturnian and Aglian types of antennae. The subfamily is distinguished by the small non-segmented palpi. The genera with antennae similar to the Aglian type (*Ludia* and allies, text-fig. 2) have no patch of shining, entire, modified scales at the bases of the wings (forewing below and hindwing above), and the genera with multiple sensory cones on the distal segments of the antennae (*Goodia* and allies, text-fig. 3) differ from the *Saturniinae*, which likewise have multiple cones, in neuration, the cross-vein D^2 (between veins 5 and 6) of the forewing having in all *Ludiinae* (as in many *Agliinae*, but not in *Saturniinae*) the same direction (or nearly) as cross-vein D^3 (cf. text-figs. 4, 5, 72–79).

The division of the subfamilies into tribes of genera is a matter which will be discussed under each subfamily.

It is perhaps not unnecessary to state that we arrived at our view on the classification of the *Saturnioideae* by commencing to group together the species which, from their morphology, appeared to us more or less closely related. This led to the formation of large groups and the discovery of gaps, and when these natural associations had absorbed all but a small number of evidently aberrant forms, we tried to find out whether the species thus associated with one another exhibited any morphological distinctions common to all the species of a group. Such characteristics of large groups do not lie on the surface.

It is, of course, much simpler to seize upon any structure and divide up a family according to the presence or absence of this or that morphological detail regardless of true affinity.

Subfamily: **Ludiinae** Auriv. (1904).

Ludiinae Aurivillius, *Arkiv Zool.* ii. 4. p. 21 (1904).
Holocerinae Packard, *Monogr. Bombyc. Moths*, iii. p. 144 (1914).

The *Ludiinae* * have affinities to the other *Saturniidae* as well as to the *Ceratocampidae*, and evidently branched off far back in the history of the *Saturnioideae*.

Palpus short, non-segmented, third segment absent. Oral margin of frons not produced into a median lobe. Second cross-vein D^2 of forewing (text-figs. 4, 5) transverse, not inclining basad. Hindtibia with one pair of short, serrate spurs.

The labial palpus usually shows a slight constriction when denuded, indicating the joint between the first and second segments, but there is no movable joint in any of the species, nor is there anywhere a distinct remnant of the third (apical) segment. The tongue is reduced to two small tubercles in some genera, while in others it remains quite distinct, though weak and without function. The oral margin of the frons (or clipeus) is convex, but does not project in the centre as a lobe; in two genera (*Orthogonioptilum* and *Carnegia*) the lateral angles are raised into a tubercle, in which the labrum participates. The antennae are most

* *Falcatulula brunneata* Strand, *Archiv Naturg.* lxxviii. A. 6. p. 143 (1912), described from Spanish Guinea as a new genus and species of *Ludiinae*, is a Geometrid, subfamily *Boarmiinae*. I have seen the specimen in the Berlin Museum.

interesting, the genera with a single (sometimes rugged) sensory cone on the distal segments of the antennae (tribe *Ludiicae*, text-fig. 2) have the adjacent branches of consecutive segments of the ♂-antenna contiguous at their bases as in the *Agliinae*, but in the second tribe (*Goodiicae*, text-fig. 3), with the multiple sensory cones of the *Saturniinae* on the distal segments, the adjacent branches of the ♂-antenna are either contiguous at their bases as in the *Agliinae* or separate as in the *Saturniinae* (excepting some also otherwise aberrant forms of this subfamily). We have, therefore, here combined in one subfamily some characters which in other Saturnians distinguish whole subfamilies from one another. The recurrence of the same or similar morphological features in different tribes,

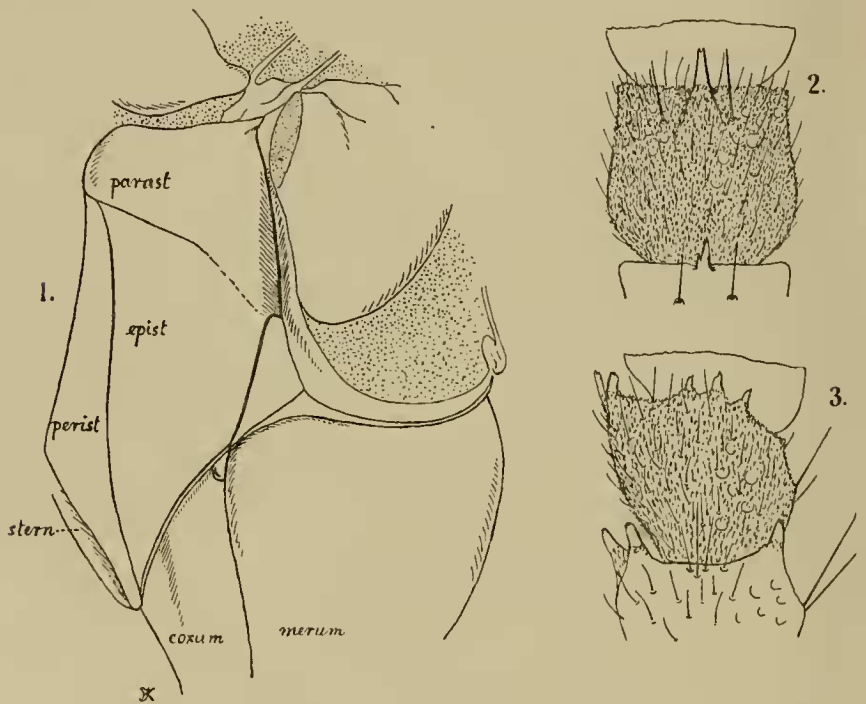


FIG. 1.—Mesosternite of *Ludia delegorguei* ♀; lateral aspect.
FIG. 2.—Segment of antenna of *L. delegorguei* ♀; ventral aspect.
FIG. 3.—Segment of antenna of *Orthogonioptilum smithi* ♂; ventral aspect.

subfamilies, and families is a frequent and most interesting phenomenon, no less important in its bearings for the evolutionist than for the systematist. Community of certain features is not necessarily evidence of close relationship. The evidence requires to be corroborated and to be weighed. If the Saturnians were strictly divided according to the sensory cones of the antennae, *Goodia* and allies would go to the *Saturniinae*, and *Ludia* and allies to the *Agliinae*. If the position of the branches of the ♂-antennae were taken as a basis, *Goodia* would be placed with the *Saturniinae* and all the other *Ludiinae* with the *Agliinae*. These are examples of artificial classification. The multiple sensory cones are a later development than the simple ones. In *Orthogonioptilum* the cones are concentrated on the median, apical, process of the segment.

The ♀-antennae vary in the subfamily from being simple to being quadripectinate nearly as in the ♂, but with the branches shorter. The distal segments are always simple in both sexes and the bristles (as distinguished from the covering of short, thin hairs) are short, there being never any long ones either on the branches or on the shaft. The upperside of the shaft is scaled to a more or less great extent, but the scales are easily worn off.

The foretibial epiphysis is larger in the ♂ than in the ♀; it is absent or much reduced in the ♀ of *Goodia* and missing in both sexes of *Vegetia*. The hindtibia bears one pair of spurs, which resemble those of the midtibia, being short and serrate. The spines of the tarsi are restricted to the undersurface. The pulvillus is present in all genera but *Vegetia*, in which genus the black apical pad is absent, the pale basal portion of the pulvillus remaining as a small triangular lobe (the pulvillus is also absent in a few *Saturniinae* and *Agliinae*).

The relatively large size of the parasternum of the mesosternite in which the *Ludiinae* (with the exception of *Goodia*) approach the *Ceratocampidae* is a further interesting feature (text-fig. 1).

The neuration is similar to that of certain *Agliinae*, f.i. *Hylesia*, the chief distinction from the other African Saturnians being found in the position of the cross-veins in the forewing. The second cross-vein, D^2 (text-figs. 4 and 5), is a direct continuation of D^3, being always long and forming with R^1 (= vein 6) an angle varying from being acute to being slightly over 90°. In the *Saturniinae* and many *Agliinae* D^2 inclines basad, more or less. There are three well-developed subcostals, and in several genera SC^3 is present as a short, weak, fourth branch thrown off SC^4 near the apex of the wing; first subcostal from the cell, or from angle, or from beyond cell, the subfamily presenting all stages in the distad movement of this vein. In the hindwing R^1 and R^2 (text-figs. 114–117) are separate, and the upper cell-angle is obtuse; cross-vein D^3 is longer than D^2, curved, with the upper end directed apicad; one submedian vein.

Larva urticating, woolly, first stage essentially similar in structure to last; head small; segment I. with two, II. to XII. with three low tubercles on each side, dorsal ones of XI. united to form a single medium tubercle of somewhat larger size; I. to III. with small additional tubercle above leg; dorsal one of I. small; dorsal, subdorsal, and spiracular tubercles with smooth, pointed spines and long hairs, which latter are either plumose or bear minute-pointed projections; similar microscopic teeth on most of the numerous hairs dispersed on head and body (text-figs. 6–11).

Cocoon tough but not compact, and usually covered with bits of leaves. Pupa not glossy, densely granulated; mesonotum without a pair of tubercles, metanotal tubercles, if present, transverse, approximated; no deep grooves on dorsal side of cremaster; the armature of the cremaster consists of teeth (*Ludiicae*, text-figs.) or involute spines (*Goodiicae*). Pupa and larva not known to us of *Orthogonioptilum*, *Carnegia*, and *Vegetia*. The caterpillars of some species are known to be exceedingly variable in colour and pattern.

Distribution: Africa, from the Cape of Good Hope to Senegambia and Abyssinia; no representative known from Madagascar.

A. Tribe: **Ludiicae.**

Distal segments of antennae with a single ventral apical sensory cone. Forewing beneath and hindwing above without basal patch of shining, entire, modified

scales. Claws of tarsi non-serrate or serration vestigial. Eighth addominal tergite not modified, not produced in middle, but sometimes with large teeth laterally and small ones medianly.

1. Forewing with four subcostals, the first from beyond cell (text-fig. 4). Antenna of ♀ simple. Hindwing without orange ocellus. Long hairs of larva not plumose, with very short pointed projections (text-fig. 10). Cremaster of pupa a transverse ridge, armed with some large teeth (as in text-figs. 15, 16) *Holocera*

2. As before. ♂-antenna quadripectinate to near tip. Hindwing with orange ring . . . . . *Pseudoludia*

3. Forewing with three subcostals, first from beyond cell (text-fig. 5). Antenna in ♂ quadripectinate to one-half or three-fourths of length, in ♀ also quadripectinate. Hindwing with orange ring. Long hairs of larva plumose (text-figs. 7–9, 11). Cremaster of pupa subcylindrical, truncate, with apical belt of teeth which project laterad (text-figs. 17, 18) . . . . *Ludia*

4. Epiphysis of foretibia and pulvillus absent (both present in the previous genera) . . . . . *Vegetia*

B. Tribe: Goodiicae.

Distal segments of antenna with several ventral sensory cones (text-fig. 3), in *Orthogonioptilum* and *Carnegia* more or less restricted to a ventral apical process or projection. Forewing beneath and hindwing above with patch of modified scales at base. Abdominal tergite VIII. of ♂ with prominent median lobe or process. Claws of tarsi distinctly serrate. Spines of tarsi reduced to hairs except apical pair of fourth foretarsal segment of ♀.

5. Forewing with first subcostal nearly always from cell. Lateral oral angles of frons not tuberculiform. Adjacent branches of ♂-antenna separate at their bases; ♀-antenna simple. Long hairs of larva plumose. Cremaster of pupa with involute spines . . . . . *Goodia*

6. Forewing with first subcostal from beyond cell. Lateral oral angles of frons tuberculiform. Adjacent branches of antenna contiguous at their bases; ♀-antenna quadri- or bipectinate . . . . . *Orthogonioptilum*

7. As before, anal angle of hindwing produced in both sexes as a lobe curved towards abdomen. Termen of forewing bisinuate in ♀ . . *Carnegia*

A. Tribe: Ludiicae.

1. Genus: Holocera Feld. (1874).—Typus: *smilax*.

Saturnia (*Henucha* ?). Westwood, *Proc. Zool. Soc. Lond.* p. 59 (description of antennae and neuration).

Henucha Walker (ex Westwood, laps. calami, pro *Heniocha* Hübn.), *List Lep. Ins. B.M.* vi. p. 1331 (1855) (partim); Sonth., *Essai Classif. Lép.* iv. p. 40 (1904) (partim).

Holocera Felder, *Reise Novara, Tafelerklärung.* p. 5 (1874) (nom. nov. pro *Henucha smilax* Westw.); Auriv., *Ent. Tidskr.* p. 120, footnote (1895) ("*Bolocera*" of Kirby and others laps. calami); id., *Arkiv. Zool.* ii. 4. p. 21 (1904); Karsch, *Ent. Nachr.* xxii. p. 252 (1896) (correction of "*Bolocera*"); Strand, *Iris*, xxv. pp. 111 and 119 (1911) (key; distinctions from *Ludia*); Pack., *Mon. Bombyc. Moths*, iii. p. 145 (1914).

Bolocera (!), Kirby, *Cat. Lep. Het.* p. 774 (1892); Roths., *Nov. Zool.* ii. p. 50 (1895).

Differs from *Ludia* chiefly in the forewing having four subcostals instead of three, and in the ♀-antenna being simple. No orange ocellus on hindwing.

Long hairs on tubercles of larva not plumose, with short dispersed projections. Apex of pupa slanting ventrally, cremaster a transverse ridge armed with teeth which are more or less curved dorsad. Frons strongly narrowed orad, considerably narrower above oral margin than the eye is high (transversely). Genal grooves vestigial. Mouth-parts as much reduced as in *Ludia*, individually variable in detail.

Antenna of ♂ quadripectinate not quite to middle segment, 11 to 15 segments being pectinate and 17 to 21 bearing short lateral ciliated projections. In ♀ simple, dorsally from base to about middle flattened and provided with a very thin stripe of narrow scales (in the worn antenna a non-pubescent stripe shows where the scales have been in the fresh specimen); all these segments except the apical one broader than long, those of proximal half of antenna more or less rounded on the sides, especially strongly in *H. rhodesiensis*. Distal segments in both sexes with one apical sensory cone, which is truncate or sinuate. Legs as in *Ludia*, but the sole of the fifth mid- and hindtarsal segment scaled, and the sensory plantar bristles of the fifth foretarsal less numerous. Epiphysis of foretibia large in both sexes, larger in ♂ than in ♀. Lobe of paronychium narrow; pulvillus large. Claw non-serrate. Wool of thorax not intermingled with long white oar-scales; but such scales present in fresh specimens of some species on the abdomen, especially at the bases of the tergites, where this pale scaling forms a sort of transverse bands; similar scales on the wings.

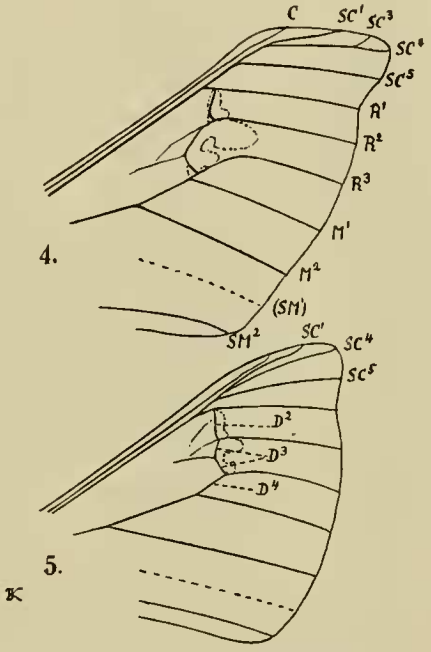


Fig. 4.—Forewing of *Holocera smilax* ♀.
Fig. 5.—Forewing of *Ludia delegorguei* ♀.

Neuration: Forewing with four subcostals (text-fig. 4), all branching off beyond cell, SC^3 being present and originating from SC^4 near apex of wing, being sometimes reduced to a small spur; D^1 short. C of hindwing incurved before apex in both sexes. Stridulation-organ of ♀ strongly developed. Scales of stridulation area of forewing all or nearly all with the edge turned towards the surface of the wing; these scales nearly erect or curved distad; costal spikes of hindwing strongly chitinised, narrower than in *Ludia*.

Genitalia: ♂. Eighth tergite (VIII. t., text-fig. 13) strongly chitinised at apex, the apical margin armed with strong pointed teeth; a broad membranous flap projects from this margin over the base of the tenth tergite, concealing the ninth tergite. No dorsal humps on tenth tergite; apical process strongly chitinised, short, divided into two lobes (text-fig. 12). Tenth sternite (X. st) triangular. Clasper (Cl) broad from base to apex, apically sinuate; on inner surface of clasper a large, transversely convex, hairy, soft flap originates from dorsal margin near base and projects distad, the clasper, when viewed from the

inner side, resembling a gardening glove of which the flap is the thumb. Penis-sheath stouter than in *Ludia*.——♀. Vaginal sclerite (text-fig. 14) with a median lobe as in *Ludia*, but the lobe much smaller. The area between this sclerite and the anal valves (segments IX. + X.) not membranous as in *Ludia*, but strongly chitinised, blackish brown, forming the roof of a large depression or cavity; this roof not flexible to any large extent, the anal claspers and the vaginal sclerite remaining separate even in contracted specimens.

Forewing of ♂ much more falcate than in ♀; in hindwing the subcostal in ♂ farther away from apex of cell than in ♀, and the discocellular D^2 (which is often transverse in ♀) more oblique. Vitreous spot of forewing larger in ♀ than in ♂, individually very variable.

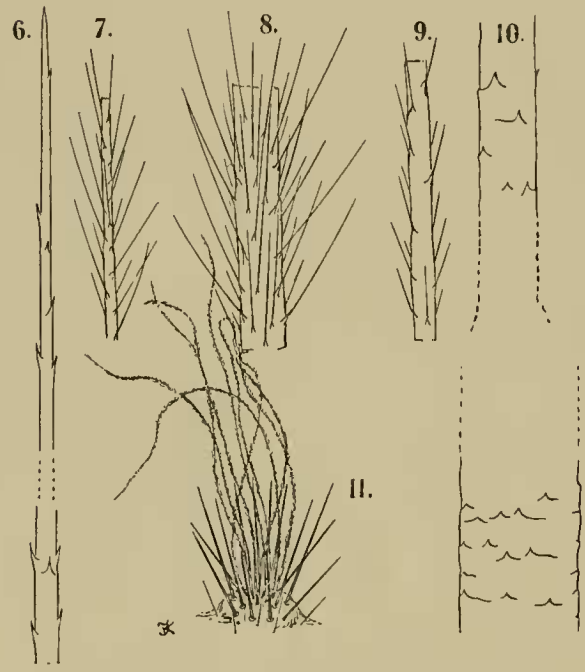


FIG. 6.—Short hair from body of larva of *Ludia delegorguei*.
FIG. 7. Long hair from dorsal tubercle of young larva (first instar) of *L. o. limbobrunnea*.
FIG. 8.—Long hair from dorsal tubercle of adult larva of *L. delegorguei*.
FIG. 9.—Long thin hair from infrastigmatical tubercle of *L. delegorguei*, adult larva.
FIG. 10.—Long hair from dorsal tubercle of *Holocera smilax*, adult larva.
FIG. 11. Suprastigmatical abdominal tubercle of adult larva of *L. delegorguei*.

Early stages: Larva (adult) woolly as in *Ludia*, segment I. with two tubercles on each side, the dorsal one small, with a few spines, the lateral one large, spiniferous; II. to XI. with three spiniferous tubercles each side, but the two dorsal ones on XI. united into a single median tubercle which is larger than the others; XII. with two each side; I. to III. with an additional, small, but distinct tubercle above the legs bearing some long, stiff setae corresponding to the spines of the other tubercles. In centre of infrastigmatical tubercle two or three long setae which are widened at the base; similar setae on dorsal tubercles, usually two, no such setae or only one here and there on subdorsal tubercles. The small hairs on head and body spiniferous, the projections shorter than in *Ludia*. The long hairs and long setae also spiniferous (text-fig. 10), not pilose as in *Ludia*; the projections short and more numerous in proximal half of hair or seta than in distal half, and absent or vestigial on the swollen basal portion, which is practically smooth. Short hairs more numerous and stouter on thorax than on abdomen. Spines of tubercles smooth. Two individual colour-forms: a cingulate form and a reticulate or

almost unicolorous one.——Pupa with the cremaster dentate as in *Pseudoludia*, teeth more numerous. Cocoon essentially as in *Ludia*.

Food-plants: *Quercus, Jasminum, Psidium, Cussonia, Uapaca, Protea.*

Distribution: Africa south of the Sahara; not yet recorded from Abyssinia proper and Somaliland, the Blue Nile being the most north-easterly locality where the genus has as yet been found.

Key to the species:

1. Costal half of hindwing above pink . *H. agomensis* (Pl. 1, fig. 15 ♀, 22 ♂)
   Costal half of hindwing above not pink 2
2. Forewing above with ferruginous subcostal patch between vitreous spot and postdistal line contrasting strongly with rest of median band *H. rhodesiensis* (Pl. 1, fig. 6 ♀)
   Forewing without prominent ferruginous subcostal patch; antemedian line slaty grey below cell, thin and usually distinctly angulate *H. angulata*
   As before; antemedian line not or very feebly angulate below cell, broader and of the same colour as the triangular costal area . . . *H. smilax*

1. Holocera smilax Angas (1849).

Saturnia smilax Angas, *Kafirs Illustr.* explan. of tab. 30. fig. 12 (1849) (Zululand).

Saturnia (*Henucha* ?) *smilax*, Westwood, *Proc. Zool. Soc. Lond.* p. 59. no. 31 (1849) (Pt. Natal; description of ant. and ocurat.).

Henucha (!) *smilax*, Walker, *List Lep. Ins. B.M.* vi. p. 1333. no. 3 (1855) (Pt. Natal); Sonthon., *Essai Classific. Lép.* iv. p. 40. no. 1. tab. 6. fig. 1 (1904) (Cape).

Holocera smilax, Felder, *Reise Novara, Lep.* p. 5. tab. 88. figs. 4, 5 (1874) (Pt. Natal); Pack., *Mon. Bombyc. Moths*, iii p. 146. tab. 33. fig. 9 larva, tab. iii. figs. *a* ♂, *b* ♀ (1914) (Natal).

Bolocera (!) *smilax*, Kirby, *Cat. Lep. Het.* p. 774 (1892) (Natal); Roths., *Nov. Zool.* ii. p. 50. no. 1 (1895).

Ludia smilax, Fawcett, *Trans. Zool. Soc. Lond.* xv. p. 305. no. 7. tab. 49. fig. 6 larva, 7 cocoon (1901) (Natal; on oak, takes *Jasminum pubigerum*).

Henucha (!) *smilax*, Fawcett, *l.c.* xvii. p. 171. tab. 6. fig. 35 larva (1903) (Durban, on Guava [*Psidium*]).

As a rule vinaceous cinnamon, with chestnut median band; but variable in tint, the brightest specimens having the terminal area of both wings ochraceous. Antemedian line straight, without an angle below cell or the angle vestigial; the posterior portion of this line of the same tone of colour as the triangular costal area. Postdistal line forming with costa on distal side an angle varying from about 60° to 85°. On forewing a triangular costal area from base to near bent of costa pale, shaded with grey, especially in ♀, bounded by the median vein and the median band. In this area a blackish brown costal spot, which represents the costal end of the antemedian line, with which the spot is sometimes connected. The median band on outside deeply incurved below middle, the terminal area being broader in front of M^3 than the median band. Vitreous mark variable, but always large; sometimes the two arms of the second spot meet, separating a scaled dot.——Tormen of hindwing incurved in ♂, convex in ♀, even in both sexes or faintly undulate, in forewing of ♀ sometimes very uneven.

Scales on stridulation-area of ♀ mostly curved distad, few lying flat on the wing, many pointed, and a large number with the upper edge excurved near base (cf. p. 247).

Genitalia: ♂. Eighth tergite (VIII. t., text-fig. 13) with the apical edge

dentate, and usually blackish, but the median teeth often quite short. Clasper, cf. text-figs. 12 and 13.——♀. Vaginal sclerite, cf. text-fig. 14.

Larva dichromatic: cingulate form yellow (creamy buff in blown specimens), with black rings bearing the black tubercles, spines black, hairs white; head entirely red, pronotum, anal segment, thoracic legs and inner surface of abdominal legs also red; above legs a black, more or less interrupted, stripe. Short hairs of thorax black.——Reticulate form: red, numerous bluish black spots and dots edged with yellow, smaller than the tubercles and arranged in five transverse, irregular bands on each segment; the spots smaller and more irregular

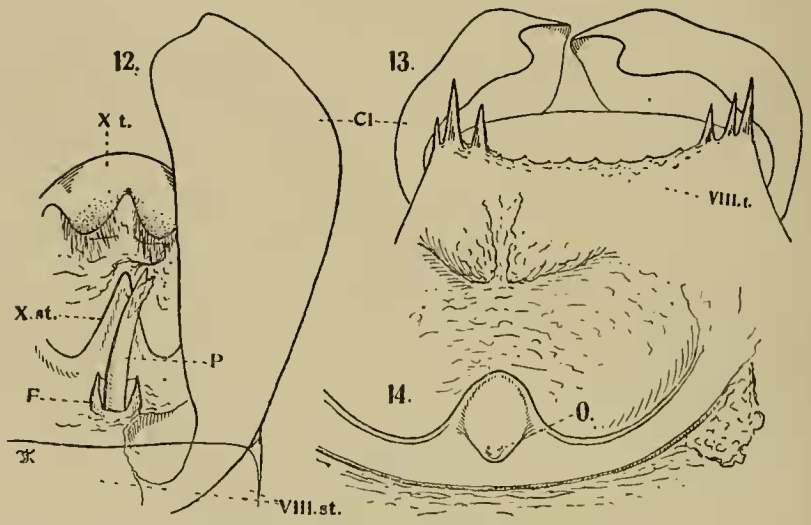


FIG. 12.—Genitalia of *Holocera smilax* ♂; ventral aspect.
FIG. 13.—Genitalia of *H. smilax* ♂; dorsal aspect.
FIG. 14.—Genitalia of *H. smilax* ♀; ventral aspect, O = aperture.

on segments I. and II. and on underside; spines pale, hairs white, long central setae of tubercles dark basally.

Cocoon on bark of trees.

Food-plants: Oak, jessamine (*Jasminum pubigerum*), guava (*Psidium*), according to Fawcett.

Fawcett's statement that the tubercles are longer in the larva from Durban than in those from Maritzburg is probably due to an error of observation. In the Durban larva figured by Fawcett and Packard (of the reticulate form) the blue spots are larger than in our specimens, and the tubercles are represented as having no long setae. Our examples from Durban have such setae.

Hab. Cape Province northwards to Mombasa, Kilimanjaro, N. Nyasaland, and N.W. Rhodesia.

In the Tring Museum a series from: Grahamstown and Transkei, Cape Province; Durban, Natal; Transvaal.

In Mus. Brit. a series from: Cape Province, Natal and Transvaal. Also from: Mombasa, 1 ♂; Kilimanjaro, 1 ♀; Ulange, Nyasaland, 1 ♀; Solwezi, N.W. Rhodesia, 2 ♀♀.

Also a series in Mus. Oxon., Mus. J. J. Joicey, and Mus. Berlin.

The specimens in the British Museum from tropical East and Central Africa are most interesting. They prove that *H. smilax* and the following species, *H. angulata*, are both found in these districts. This fact would render it comparatively easy for a resident naturalist to prove or disprove the specific distinctness of *H. smilax* and *H. angulata* by breeding from the egg.

2. Holocera angulata Auriv. (1893).

Bolocera smilax, Schaus & Clem., *Sierra Leone Lepid.* p. 29 (1893).
Holocera angulata Aurivillius, *Ent. Tidskr.* xiv. p. 201. no. 5 (1893) (Sierra Leone; Camerun).

The differences from *H. smilax* are not so trenchant as one would wish them to be. At first sight the two insects appear to be geographical forms of one species; but as they are synpatric in the eastern tropical districts of their ranges, the evidence seems to favour the opinion that they have already acquired the independence of species.

Individually variable from bright cinnamon-rufous to a dull drab-brown, in the latter case the median band blackish chestnut. Antemedian line of forewing, *upperside*, usually sharply exangulate on submedian fold, and between cell and hindmargin narrow and of a slate-grey colour; postdistal line costally more strongly curving basad than in *H. smilax*, forming a smaller angle with the costal margin. Vitreous mark very unstable: in ♂ sometimes reduced to a short and narrow line; in ♀ the second spot often enlarged and triangular, enclosing a scaled dot; but usually as in *H. smilax*.——On hindwing the median band and the grey lines bounding it less prominent than in *H. smilax*. Vitreous spot usually small and transverse in ♂, mostly not transparent; in ♀ varying from being a transparent bar to forming a complete ring enclosing a scaled dot, in most specimens the vitreous mark an externally open halfring, irregular, and of variable size.

Genitalia of ♂ as in *H. smilax*, but the margin of the eighth tergite always pale and usually armed with one to three lateral teeth only, occasionally with small teeth along the median portion in addition. Dorsal margin of clasper more excurved than in *H. smilax*.——♀. Median lobe of vaginal sclerite usually more rounded than in *H. smilax*.

Larva not known. Possibly the black larvae found by Sjöstedt belong here (*Ludia* ? sp., Auriv., *Arkiv. Zool.* ii. 4. p. 15. no. 45 [1904]).

Hab. Senegal southward to Angola, Mashonaland, Mozambique, Nyasaland, British East Africa, and Blue Nile.

Two subspecies:

(*a*) H. angulata angulata Auriv. (1893).

Holocera angulata Aurivillius, *l.c.* (1893) (Sierra Leone; Camerun); id., *Arkiv Zool.* ii. 4. p. 14. no. 42 (1904) (Camerun).
Bolocera (!) *angulata*, Rothschild, *Nov. Zool.* ii. p. 50. no. 2 (1895).
Holocera angulata ab. *bistricta* Strand, *Iris*, xxv. p. 113 (1911) (Camerun).
Holocera angulata var. *guineensis* Strand, *Arch. Naturg.* lxxviii. A. 6. p. 145. no. 15 (1912) (Spanish Guinea).

♂. Vitreous mark of forewing not larger than in *H. smilax*, usually smaller, sometimes almost obliterated. Terminal area of both wings vinaceous (Ridgway, *Nomencl. Colours*, iv. 17), on hindwing scarcely at all contrasting with the median

band. In one of our Gambaga ♂♂ the antemedian line of the forewing shows only a trace of the angle on the submedian fold.

♀. Terminal area varying from bright cinnamon-rufous (contrasting strongly with median band) to dull drab-brown (not or little contrasting with median band); vitreous mark of forewing very variable, on an average larger than in *H. smilax*.

Hab. Senegambia to Angola, eastward to the coast of Portuguese East Africa.

In Mus. Tring from: Sédhiou, Casaman (H. Castell), 1 ♂; Sierra Leone, a small series; Gambaga, Gold Coast (Dr. Bury), a series; Prestea and Wassaw districts, inland from Sekondi, Gold Coast, 7 ♂♂; Ilesha, South Nigeria (Capt. Humfrey), 2 ♂♂, 1 ♀; Warri, Niger Coast (Dr. Roth), 1 ♂, 2 ♀♀, all three dark brown; Luluabourg, Kassai (Landbeck), 2 ♀♀; Canhoca, Angola (Dr. Ansorge), 1 ♂, 1 ♀; Solwezi and Mumbwa, N.W. Rhodesia (Dollman), 1 ♂, 1 ♀; Selukwa, Rhodesia, 1 ♂; Angoni, Nyasaland (Andrews), 1 ♂; Nairobi, Brit. E. Africa (Dr. van Someren), 1 ♂.

In Mus. Brit. from: Sierra Leone and Gold Coast, a small series; Jebba, Niger, 1 ♀; Mt. Mlanji, Nyasaland (Neave), 3 ♂♂ and pupa; Mashonaland (Dobbie), 1 ♂. Also in Mus. J. J. Joicey and Mus. Berlin.

(*b*) **H. angulata nilotica** subsp. nov. (Pl. 1, fig. 7 ♂).

♂. Macula vitrea alae anticae magna; area terminali utriusque alae ochracea.

Hab. Blue Nile; 1 ♂ in Mus. Tring.

Antemedian line of forewing not exangulate below cell, postdistal line as strongly curved basad costally as in *H. a. angulata*; terminal area ochraceous, this band tapering costad, terminating at SC^5, the apical lobe of wing being of nearly the same colour as the median band and but slightly shaded with ochraceous at the margins; triangular basi-discal costal area shaded with ochraceous; fringe with minute blackish vein-dots; vitreous mark very large, about 4 × 4½ mm., upper spot R^1–R^2 longer in basi-distal direction than broad, with a narrow and deep incision on distal side, above it in angle between subcostal stalk and R^1 a sparsely scaled dot, another dot below R^1 vitreous; lower partition R^2–R^3 of vitreous mark much longer than upper, strongly curved, its upper arm elongate-ovate, separated from ochraceous limbal area only by a very thin chestnut line and its distance from fringe little more than 1 mm.——Hindwing narrow, anal angle produced as in most ♂♂ of *H. a. angulata*, terminal area ochraceous, diffuse at apex; vitreous mark an exteriorly open ring about 1 mm. wide, with a vitreous dot above it.

On *underside* the terminal area of both wings ochraceous as above, vitreous mark of forewing larger than above, the chestnut dot situated in second spot isolated, while on upperside it is connected by a thin line with the scaled wing area.

Genitalia: Eighth tergite slightly denticulate, with two long spiniform teeth at lateral angle.

It is almost certain that some of the differences exhibited by this single ♂ from the Blue Nile are individual; particularly the ochraceous colouring of the terminal area can hardly be expected to be a constant character. The large

size of the vitreous mark of the forewing is remarkable, the spot resembling more that of a ♀ of *H. a. angulata* and *H. smilax* than that of a ♂.

3. **Holocera rhodesiensis** Janse (1918) (Pl. 1, fig. 6 ♀).

♂♀. *Holocera rhodesiensis* Janse, *Ann. Durban Mus.* ii. p. 83 (1918) (Salisbury); O'Neil, *ibid.* ii. p. 167 (1919) (Salisbury; descr. of larva; on *Cussonia*).

♂♀. Both wings dentate, especially strongly in ♀. Deep chestnut shaded with purple-grey; a costal patch in median band of forewing, an abbreviated terminal band on hindwing, the centre of the metanotum and part of the underside of the abdomen varying from ferruginous to cinnamon-rufous, sometimes the ferruginous colour much extended. Mid- and hindtarsi, except segment V., white like the middle of foretarsus.

Wings: General shape and pattern as in *H. smilax*; antemedian and postdistal lines purple-grey, conspicuous, but diffuse, antemedian not angulate below cell, postmedian less incurved below middle than in *H. smilax*; vitreous mark differs in the second spot being slenderer, anteriorly less dilated and posteriorly not (♂) or little (♀) curved distad.

Genitalia essentially as in the two previous species: Eighth tergite less strongly dentate medianly than in *H. smilax* and more than in *H. angulata*, with one to three large lateral teeth. The two apical lobes of the clasper of nearly equal size; dorsal margin of clasper less incurved than in the previous forms.—— ♀. Vaginal sclerite as in *H. smilax*, the central cavity smaller (in our only ♀).

Stridulation-organ as in *H. smilax*.

Larva dimorphic: (1) "Body and tubercles black with long downy hairs and an inferior double row of salmon-red marks." (2) "Segments ringed with black and white" (J. O'Neil).

Food-plant: *Cussonia*.

Hab. Rhodesia and Nyasaland.

In Mus. Tring from: Salisbury (J. O'Neil), 2 ♂♂, 1 ♀; Agoniland, Nyasa (Andrews), 1 ♂.

In Mus. Brit. from: Blantyre (Ambruster), 1 ♀; Mlanje, Nyasa (Neave), 1 ♂; Salisbury, 1 ♀.

4. **Holocera agomensis** Karsch (1896) (Pl. 1, fig. 15 ♀, 22 ♂).

Holocera agomensis Karsch, *Ent. Nachr.* xxii. p. 253 (1893) (Bismarckburg, Togo, April); Strand, *Iris*, xxv. p. 112 (1911).

Ludia nov. ?, O'Neil, *Ann. Durban Mus.* ii. p. 165 (1919) (Salisbury; descr. of ♂♀ and variable larva).

♂♀. Costal half or more of hindwing above and posterior half of forewing below pink, recalling *Ludia*. Lines blackish brown; antemedian line of forewing exangulate below cell, as in *Ludia* continuous to costal margin; postdiscal one less incurved than in *H. smilax*, the median band therefore less constricted below middle. Discocellular mark of hindwing black, with vitreous centre, the spot resembling the figure 3 with the upper projection truncate. Anal angle of hindwing less acuminate than in the other species of the genus.

♂. Antenna with about 15 segments pectinate and 17 non-pectinate.

♀. Scaling of stridulation-area quite different from that of the other species. The scales arranged in fairly regular transverse rows, all broad, erect, more or

less fan-shaped, apical margins sinuate and more or less irregular; the broad sides of many scales turned towards the wing.

Genitalia: ♂. Eighth tergite strongly dentate, as in *H. smilax*.

Clasper broader than in the other species; its apical sinus more shallow, the dorsal apical lobe almost effaced; dorsal fold narrow.——♀. Lobe of vaginal sclerite rather longer than in *H. smilax* and slightly sinuate at apex.

Larva very variable. O'Neil has taken "no fewer than ten different varieties of this caterpillar, each of which was quite unlike any of the others." Greyish olive with very broad dorsal band and bright yellow tubercles; or black mottled with small yellow and white spots, and large crimson tubercles; or pure white with the tubercles bright orange-red; or pale creamy-ochraceous with ochreous-brown tubercles; or "colours bright yellow and magenta," etc. Double brooded, adult larva in October and April. Cocoon very hard.

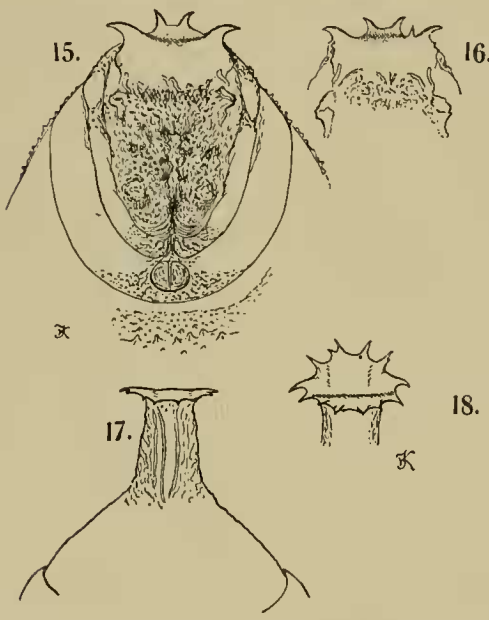


FIG. 15.—Cremaster of pupa ♂ of *Ps. suavis* ♂; ventral aspect.
FIG. 16.—Cremaster of pupa of *Ps. suavis* ♀; ventral aspect.
FIG. 17.—Cremaster of pupa of *Ludia delegorguei*; ventral aspect.
FIG. 18.—Cremaster of pupa of *Ludia delegorguei*; apical aspect.

Food-plants: *Uapaca kirkiana*, rarely on *Protea* spec.

Hab. (Togoland), Congo, Nyasa, Rhodesia.

In Mus. Tring from: Luebo and Luluabourg, Kassai, Congo, 2 ♀♀; Salisbury, Rhodesia (J. O'Neil), 1 ♂, 1 ♀; Kashitu, N.W. Rhodesia (Dollman), 1 ♂.

In Mus. Brit. 10 ♂♂, 13 ♀♀, and some pupae from: Mlanje, Nyasa (Neave); Kashitu, Chipeampa, and Solwezi, N.W. Rhodesia (Dollman); Salisbury (Marshall, O'Neil).

The locality "Togo" given by Karsch is no doubt erroneous.

2. Genus: **Pseudoludia** Strand (1911).—Typus: *suavis*.

Holocera Rothschild (nec Felder, 1874), *Ann. Mag. N.H.* (7). xx. p. 9 (1907).
Holocera (*Pseudoludia*) Strand, *Iris*, xxv. p. 112 (1911) (subgen. nov.).

Connects *Holocera* with *Ludia*, but also has peculiarities of its own.

♂♀. Genal groove distinct, as in *Ludia*. Antenna in ♂ with 19 or 20 segments quadripectinate and only 7 to 10 non-pectinate; in ♀ (text-figs. 22 and 23) simple as in *Holocera*-♀, flattened to two-thirds, the segments, particularly those in middle of antenna, slightly constricted before apex, in dorsal or ventral view

lateral humps being indicated which correspond to the branches of the ♂. Fifth segment of all tarsi in ♂ with the solo scaled, in ♀ non-scaled and densely studded with S-shaped sensory bristles.

Stridulation-scales of ♀ small, narrow.

Neuration nearly as in *Holocera* ; forewing with four subcostals, SC^2 being present as a short subapical spur ; D^1 of forewing, and in ♀ also D^1 of hindwing, longer than in *Holocera* ; C in hindwing of ♂ not recurved at apex.

Genitalia : ♂. Eighth tergite without teeth, but the margin sharp, slightly blackish, projecting. Clasper deeply sinuate at apex, on inner side with strongly chitinised black armature not present in *Holocera* and *Ludia* ; ventral margin with lobe near base, recalling *Ludia*.——♀. Genital sclerite of the *Ludia* type, the aperture more proximal than in *Holocera* and the area behind the vaginal lobe membranous as in *Ludia*, not strongly chitinised as in *Holocera*.

Larva as in *Holocera* ; dorsal tubercles with one or no seta.

Pupa as in *Holocera* ; metanotum with two approximate transverse tubercles ; granulation sharp, granules on sides of median segments more isolated than in *Holocera*, with fewer and less evident small folds radiating from each granule ; cremaster a transverse ridge armed with some teeth (text-figs. 16 and 17).

Hab. East Africa.

One species, which has on hindwing an orange ring of the *Ludia* type.

1. **Pseudoludia suavis** Roths. (1907).

♂ ♀. *Holocera suavis* Rothschild, *Ann. Mag. N.H.* (7). xx. p. 9. no. 19 (1907) (Usambara, ♂ ♀, descr. of larva) ; Jord., *Nov. Zool.* xv. p. 256. no. 18. tab. 11. fig. 11 ♂ (1908) (= *lilacina*).
♂ ♀. *Holocera lilacina* Weymer, *Ent. Zeitschr.* xxi. p. 118 (1907) (Usambara).
♂ ♀. *Holocera* (*Pseudoludia*) *suavis*, Strand, *Iris*, xxv. p. 113 (1911) (Amani ; Usambara).

♂♀. Forewing, above, chestnut-purple from base to whitish postdiscal line ; a large triangular costal area from base to near bent of costa grey like pronotum ; terminal area dull cinnamon ; postdiscal line costally much less curved than in *Holocera*, forming an acute angle with the costa on the basal side, not on the distal side.——Costal half of hindwing pinkish vinaceous ; median band terminating at upper cell angle, where it is rounded (as is usual in *Ludia*) and blackish; the band bounded by a whitish line ; yellow ocellus somewhat incurved on outer side, as in *Ludia*, enclosing a vitreous crescent edged with black.

In ♂ the forewing falcate, but rather wider at narrowest point than in *Holocera*-♂ ; termen of hindwing slightly convex, anal angle less acute than in *Holocera*. In ♀ the wings shaped almost as in *Holocera smilax*-♀, but costal margin of forewing less arched before apex and anal angle of hindwing rather more obtuse.

Genitalia : ♂. Eighth sternite (VIII. st., text-fig. 19) without median lobe, its margin not strongly chitinised. Anal tergite (x.t.) dorsally slightly depressed along centre, strongly convex laterally, but not humped as in *Ludia* ; apical process black, bilobate, the lobes rounded, the sinus deeper than in any *Ludia* and less deep than in *Holocera*. Tenth sternite (x.t.) broader than in *Ludia* and very much broader than in *Holocera*. Clasper broad from base to apex ; its ventral margin produced near base into a lobe (L) corresponding to the ventral lobe found in all species of *Ludia* ; apex of clasper (text-fig. 20) very broad, obliquely truncate-sinuate, the apical margin not continuous with the ventral

margin, but continued by a ridge which runs from the ventral angle obliquely on to the inner surface of the clasper; dorsal apical angle prolonged into an obtuse process which is slightly concave on inner side. Proximally to apical margin and about midway between the two apical angles originates a long sclerite (S, text-fig. 20) which lies flat on the surface of the clasper and curves dorsad and basad. This sclerite is somewhat prismatical at its base and more flattened elsewhere, and remains of nearly even width to near apex, which is rounded-acuminate; apical portion densely denticulate-granulate.——♀. Vaginal

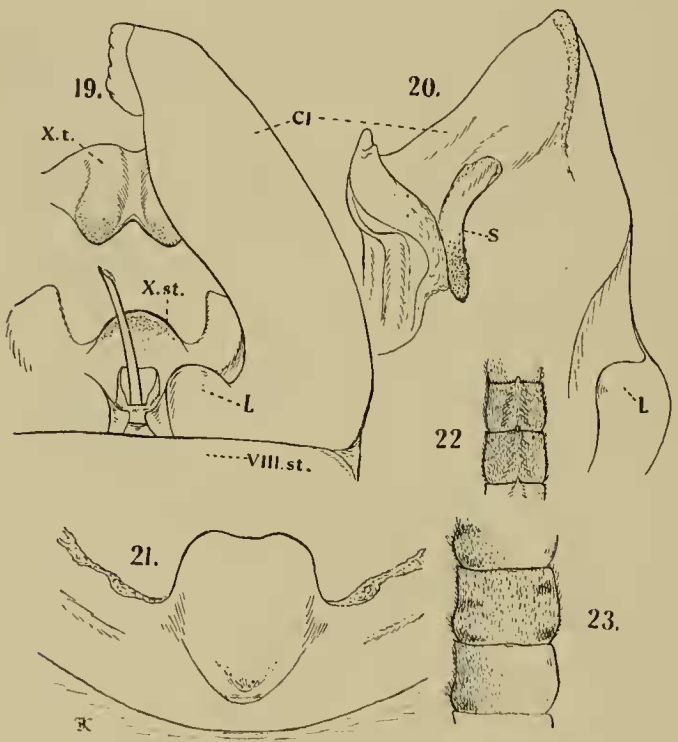


FIG. 19.—Genitalia of *Pseudoludia suavis* ♂; ventral aspect.
FIG. 20.—Clasper of *Ps. suavis* ♂; inner surface.
FIG. 21.—Genital sclerite of *Ps. suavis* ♀; ventral aspect.
FIG. 22.—Segments 22 and 23 of antenna of *Ps. suavis* ♀; ventral aspect.
FIG. 23.—Segments 11 and 12 of antenna of *Ps. suavis* ♀; ventral aspect.

sclerite broad in fronti-anal sense; median lobe larger than in *Holocera*, truncate-sinuate, cavity extending to near basal margin of sclerite; aperture placed as in *Ludia* in anterior portion of cavity.

Scales of stridulation-area in irregular rows; a large number of the scales bidentate, some sublinear, but most of them elongate-triangular, small, with the flat surface turned towards the wing; costal spiniform scales of hindwing numerous, sharply pointed, differing in size in the same individual, some being long, some short, with intermediate sizes.

Larva (adult) orange with black belts which bear the black tubercles; head,

pronotum, and anal segment also black, as are the thoracic legs, the outside of the abdominal legs, and a ventri-lateral stripe.

Pupa, see above. We have several cocoons in a half-cylinder of bark (perhaps obtained under artificial conditions in a breeding-cage ?).

Hab. Usambara, ex-German East Africa.

In Tring Museum a small series of both sexes, two blown larvae, and some pupae; also in Mus. Brit. and the Berlin Museum.

3. Genus: **Ludia** Wallengr. (1865).—Typus: *delegorguei*.

Saturnia, Boisduval (nec Schrank 1802), in Deleg., *Voy. Afr. Austr.* ii. p. 601 (1847).

Saturnia (*Henucha* ?), Westwood, *Proc. Zool. Soc. Lond.* p. 59 (1847) (partim; *Henucha* laps. cal., instead of *Heniocha* Hübn.).

Henucha, Walker, *List. Lep. Ins. B.M.* vi. p. 1331 (1855) (partim); Sonthon., *Essai Classif. Lép.* iv. p. 40 (1904) (partim).

Ludia Wallengren, *K. Sv. Vet. Ak. Handl.* (2). v. 4. p. 25 (1865) (type: *delegorguei*); Kirby, *Cat. Lep. Het.* i. p. 774 (1892); Roths., *Nov. Zool.* ii. p. 50 (1895); Auriv., *Arkiv Zool.* ii. 4. p. 21 (1904) (distinction of genus); Pack., *Mon. Bombyc. Moths*, iii. p. 149 (1914); Strand, *Iris*, xx. pp. 110, 119 (1911) (key to species; distinctions from *Holocera*).

♂♀. Forewing with three subcostals, SC^2 and SC^3 being absent (text-fig. 5). Antenna of ♀ pectinate to beyond middle. ♀ with large patch of modified scales on underside of forewing near tornus and a row of erect spiniform scales at costal margin of hindwing near apex. Long hairs on tubercles of larva plumose (text-figs. 8 and 11). Cremaster of pupa subcylindrical, truncate, with apical circlet of teeth which project laterad (text-figs. 17 and 18).

Frons moderately narrowed orad, varying in width at the genal grooves from being broader to being a little narrower than the eye is high (measured transversely). Labrum narrow, slightly convex, not prominent. Genal groove very distinct, rounded, deep. Vestige of tongue quite small, the tongue being represented by two short processes of irregular and variable shape firmly attached to the sides of the buccal cavity. Labial palpi united at the base, curved forward, scarcely distinguishable from the frons with the naked eye, being quite small, non-segmented.

The antennae consist of 32 to 37 segments, besides the scape. In ♂ 13 to 17 segments quadripectinate, the distal 16 to 19 segments with a short lateral projection on each side bearing long cilia; the apical branch of a segment touching the proximal branch of the next. In ♀ the proximal half or two-thirds bipectinate (17 to 25 segments), the apical branches of these pectinated segments indicated as short projections, which are often longer than the shaft is broad; shaft in fresh (bred) specimens dorsally scaled to apex, but as a rule the specimens have scaling only on the pectinated segments. Apical sensory cone of distal segments of both sexes single, truncate, or sinuate, sometimes rugged or subdivided, longer than in *Holocera*, especially in ♀ (text-fig. 2). Epiphysis of foretibia large, in ♂ reaching about to three-fourths of tibia, shorter and narrower in ♀, but even in this sex extending about to two-thirds. Spurs of mid- and hindtibiae somewhat shorter than the tibiae are broad when denuded; hindtibia with one pair only, as in all the *Ludiinae*. Tarsal segments I. to IV. with some apical spines at each side of ventral surface and one or several additional spines further basad, these additional spines more numerous on segment I. than on the others. Tarsal V. of ♀ with the sole non-scaled, except laterally at base; near apex of sole a fairly

dense tuft of stout, curved, sensory hairs on each side. Pulvillus large in both sexes; lobe of paronychium broad. Claw without serration or only a suspicion of it. Organ of stridulation present in all ♀♀ on fore- and hindwing (cf. p. 247). Vein C of hindwing less curved in ♀ than in ♂, distally straight or recurved.

Neuration: Forewing with three subcostals, all given off beyond cell, or the first from cell close to stalk of the two others, the short subapical spur SC^3 of allied genera absent; SC^1 variable in position, wandering from upper cell-angle distad until it branches off from SC^4 (cf. text-figs. 36, 37, 52–54).

Genitalia: ♂. Anal tergite (X.t., text-figs. 33, 40, 55) with two smooth, glossy, more or less globose dorsal swellings, one on each side, close together, feebly chitinised, more or less projecting anad, partly covering the median lobe of x.t.; this lobe black, short, simply triangular with the tip blunt, or rotundate-truncate with the apex sinuate. Anal sternite (X.st.) triangular, black, apex obtuse. Clasper long, broad in proximal half, abruptly narrowed in or before middle, the ventral margin being abruptly incurved, the lobe (L) proximal to this large sinus projecting distad, often being prolonged into one or two pointed processes (text-figs. 61–64). Penis-sheath (P) very slender, without armature; its funnel (F) open ventrally. Eighth sternite (VIII. st.) varying according to species, being acuminate, rounded, or sinuate.——♀. Sexual orifice medianly on a large, strongly chitinised, transverse sclerite, the apical margin of which is dilated behind the orifice into a large lobe. Area between this sclerite and anal valves (IX. and X.) membranous.

All species with orange ocellus on upperside of hindwing; black pupil of ocellus varying in shape and size from being a thin line or crescent to being a large rounded spot.

Larva: No essential structural difference between the first and last stages, but the first stage without definite markings. Appearance woolly in all stages. Prothorax on each side with three tubercles, upper one small, with hair only or bearing in addition one spine, third tubercle also without spines, second with spines. Segments II. to X. with three spiniferous tubercles, two above and one below the stigma, XI. like X., but the dorsal tubercle united with that of the other side to form a single, larger, median tubercle. Segments II. and III. with an additional, small, non-spiniferous tubercle above the legs. In the centre of the tubercles (text-fig. 11) a tuft of long white hairs, about ten on dorsal tubercles, fewer on the others. Some of these long hairs of the infrastigmatical tubercles have the base strongly widened, the incrassation being less conspicuous, or absent, in the hairs of the dorsal and subdorsal tubercles. Apart from the tubercles the skin studded with numerous short and long hairs. All the hairs with the exception of the short ones somewhat resemble the rays of a feather, being densely covered all round with thin, hair-like filaments (text-figs. 7–9). The short hairs on head and body are not pilose, but are studded with short dispersed spikes (text-fig. 6). The spines of the tubercles are smooth, without projections. Larva known of very few species.

Cocoon thin but tough, covered with remnants of leaves. Pupa granulose; ventral surface of last segment less rough than in *Holocera*, with a more sharply defined median groove; cremaster subcylindrical, truncate, the margin of the apical surface armed all round with a variable number of teeth which project laterad (text-figs. 17, 18); metanotum on each side close to middle line with a transverse tubercle as in *Holocera*.

Food-plants: *Microglossa mespilifolia* (*Compositae*), also on *Zingiberaceae* according to Sjöstedt, *Labiatae* according to Schultze, and probably other plants.

Distribution: Africa south of the Sahara, from Senegambia and Abyssinia to the Cape Province.

The material in collections is not extensive, and our knowledge of the distribution of the various species, therefore, is very incomplete. The great similarity in colour and pattern renders identification difficult in many cases, the more so as there is a considerable amount of individual variability. The genitalia of the male, however, are a great help; they are very distinctive, presenting differences between the species which it is easy to perceive. The genital armature of the female, on the other hand, is of a more uniform character in the different species, though not quite useless in diagnostic work. In some of the species the female-antennae are different and afford a means of recognising the species. The vitreous discocellular mark of the forewing, on which Strand's key to the species is chiefly based (*Iris*, xxv. p. 110), is not so constant as Strand believed it to be.

Key to the species:

1. Fore- and hindwing with a row of conspicuous, irregular, black patches in the pale terminal area; postdiscal line of forewing above dentate upon the veins, the teeth pointing distad . *L. corticea* spec. nov. (Pl. 1, figs. 11 ♂, 19 ♀)

2. No such patches. Antemedian line of forewing not exangulate below cell; ocellus exceptionally small; vitreous mark of forewing very large in ♂, eighth sternite of ♂ with long, pointed, very narrow, median process *L. tessmanni* (Pl. 1, figs. 8 ♂, 16 ♀)

Orange ring without white scales on outer portion; anal angle of hindwing produced; forewing beneath with large white submarginal patch posteriorly; antenna of ♀ with long pectinations to near apex. *L. dentata* (Pl. 1, fig. 5 ♀)

Colouring different 3

3. Prevailing colouring above and beneath brownish grey; postdiscal line of forewing above regularly crenate, the teeth pointing basad; termen of both wings scalloped, fringe pale between the teeth or almost entirely pale; pupil of ocellus a linear crescent. Eighth sternite of ♂ strongly acuminate, clasper broad at apex . . . . . *L. arguta* spec. nov. (Pl. 1, fig. 9 ♀)

Postdiscal line of forewing not regularly crenate, or termen not regularly scalloped 4

4. Males (this sex not known of *L. pupillata* and *L. syngena*) . . 5

Females 8

5. Median lobe of eighth sternite rounded 6

Median lobe of eighth sternite strongly acuminate *L. orinoptena* (Pl. 1, fig. 1 ♂)

6. Clasper ending with a long, pointed hook; termen of hindwing not angulate . . . . . *L. delegorguei* (Pl. 1, figs. 12 ♂, 13 ♀)

Clasper with shorter apical hook; termen of hindwing angulate below middle . . . . . *L. goniata* (Pl. 1, fig. 14 ♂)

Clasper broad at apex 7

7. Ventral lobe of clasper with one process . . . . *L. hansali*

Ventral lobe of clasper with two processes *L. obscura* (Pl. 1, fig. 10 ♂)

8. Females. Postdiscal line of forewing straight from its bent to hind-

margin ; on both wings a shadowy brown band between postdiscal line and termen. Antenna pectinate to one-half . . *L. goniata* (Pl. 1, fig. 4 ♀)

Postdiscal line of forewing incurved below middle. Antenna pectinate to two-thirds or beyond 9

9. Postdiscal line of forewing above bordered on outside by a broad whitish or brownish grey band which fades away distally ; if the band is narrow, then the underside has a greyish white postdiscal line or diffuse band . . 10

Postdiscal line bordered by a narrow pale line, which more or less widens posteriorly, but is fairly sharply defined ; no greyish white postdiscal line or band on underside 11

10. Border of postdiscal line of forewing greyish white *L. delegorguei* (Pl. 1, fig. 21 ♀)

Border of postdiscal line of forewing brownish grey, duller ; vitreous mark of forewing usually very thin . . . *L. hansali* (Pl. 1, fig. 20 ♀)

11. Antemedian line of forewing forming a right angle on submedian fold ; postdiscal line hardly at all widened behind ; short grey oblique apical line narrow. Orange ring thin, black centre very large ; red area sometimes suppressed above . . . . . *L. obscura* (Pl. 1, fig. 17 ♀)

Submedian angle of antemedian line usually obtuse ; postdiscal line widened behind ; short grey apical line broad, diffuse ; upper vitreous mark more or less distinctly separated from second spot ; postdiscal line on underside of hindwing incurved before reaching abdominal margin . *L. orinoptena* (Pl. 1, fig. 2 ♀)

Submedian angle of antemedian line as in *L. obscura* ; postmedian line slightly widened behind ; upper arm of lower vitreous spot longer than its distance from postdiscal line. Black centre of ocellus a narrow crescent *L. syngena* (Pl. 1, fig. 3 ♀)

Postdiscal line on both fore- and hindwing ending at a considerable distance from tornus. Pupil of ocellus a short and nearly straight line ; discal band of hindwing scarcely half as wide at abdominal margin as above ocellus *L. pupillata*

1. **Ludia corticea** spec. nov. (Pl. 1, figs. 11 ♂, 19 ♀).

Utraque ala maculis nigris sublimbalibus ornata ; area media alae anticae nigra extus dentata ; corpus supra nigrum.

Al. ant. long. ♂ 20 mm. ; ♀ 32 mm.

Al. ant. lat. ♂ 9 mm. ; ♀ 16 mm.

Hab. Eros Mts., 1,150 m., 7 km. from Windhoek, S.W. Africa, one pair, and Windhoek (two ♀♀) in the Tring Museum ; also in the Berlin Museum.

♂. Body, antenna and legs deep brownish black ; pronotum slightly paler, edged with dark cinnamon ; basal area of patagium also dark cinnamon, dorsally shading into creamy buff and here sharply defined. Antenna with 14 segments quadripectinate, 17 non-pectinate, the longest branches equalling in length three and one-half pectinated segments.

Forewing, *upperside* : Cell from base to antemedian line dirty creamy buff shaded with grey ; costal margin grey to apex of cell, speckled with dark olive-brown ; below cell a dirty creamy-buff patch bounded by the antemedian line, base up to this patch brownish black. Antemedian line excurved in cell and more strongly so between cell and hindmargin, being strongly angulate upon base of M^3. Median area nearly black, but with numerous creamy-buff scales,

which are not much in evidence except under a lens ; upper scales of this area bidentate, nearly all the pale ones broad, gradually widened. Postdiscal line incurved between the veins, rather conspicuously dentate, particularly on the posterior veins, below SM^2 3 mm. distant from apex of this vein. Upper vitreous bar nearly straight, crescent thinner than bar, not projecting anteriorly. Terminal area dirty creamy buff shaded with cinnamon distally, especially in upper half ; between the veins numerous black specks condensed to form a row of patches, which are as deeply coloured as the median area and are quite prominent on the pale ground. Termen dentate, teeth R^3 and M^1 more projecting than the others. ——Hindwing dentate, rather strongly incurved above anal angle, which projects. Red area deep pink, extending to apex of wing and invading abdominal area below cell. Orange ocellus small, its diameter (2·5 mm.) shorter than the distance from termen ; black crescent in ocellus thick ; a whitish spot in sinus ; orange scales and white ones sharply bidentate. Black area encircling ocellus widest in cell, narrowed costad, paler posteriorly, where it assumes a slight bluish tint. Postdiscal line almost even, somewhat curved in S-shape, being incurved below M^3, ending near anal angle, but with the extreme end curved basad. Outside this line, and separated from it by a thin pale buff line, a row of black spots, better defined and more compact than on forewing, the row extending forward to R^1. Fringe black on both wings, whitish midway between the veins.

Underside : On forewing the costal area greyish irrorated with black ; median area brown-black ; pink patch nearly extending to tornus. Postdiscal line dentate. Limbal area as above, but wider in lower half, spots conspicuous except spot SM^1–SM^2, which is obsolete.——Hindwing grey irrorated with numerous blackish brown specks and transverse spots. Terminal area shaded with cinnamon, the blackish scaling more extended than above. Postdiscal line incurved anteriorly and posteriorly, in anterior half thick, diffuse, in posterior half thin and indistinct. Upper scales as on forewing bidentate, the teeth well projecting and in most scales far apart, especially in basal half of hindwing, rarely a small additional tooth in centre.

♀. Similar to ♂, but much larger. Apex of forewing less produced ; pronotum somewhat paler. Vitreous crescent anteriorly projecting distad a short distance. Brownish black median area with bluish tint in certain aspect.——Blackish shading of costal margin of hindwing extended backwards to near black median band, almost isolating a red subapical spot. Orange ring 4·5 mm., its distance from termen 6 mm. ; the black crescent heavy, more than half the thickness of the ring ; white spot distinct ; orange upper scales mostly tridentate, many bidentate, the lower orange scales on proximal side of black crescent quadri- or quinquedentate. Black median band with bluish tint from ocellus backward.

Underside coloured as in ♂ ; terminal area of forewing more irrorated with grey along the postdiscal line ; red patch not extending beyond this line, but invading cell. As in ♂ the blackish submarginal spots R^1–R^3 enlarged and confluent. Upper scales in outer half of underside bidentate, broad, the teeth strongly divergent, at least in most of the pale scales ; many scales with a small central tooth, which rarely attains the length of the lateral teeth.

Stridulation-area of forewing reaching a little above M^2 ; its scaling as in *L. delegorguei*, but with few flat and dentate scales, and the curved ones on the whole more pointed.

Antenna of ♀ with 20 or 21 segments pectinate, 15 or 14 non-pectinate, the

proximal ones of these non-pectinate segments dentate, the distal ones nearly, simple ; the longest branches not quite as long as three segments ; apical branches in basal half of antenna indicated as very short projections ; underside of pectinated segments non-carinate, transversely convex, rounded, appearing somewhat swollen.

Genitalia : ♂. Eighth sternite (VIII. st., text-fig. 24) deeply sinuate, the sinus rounded, with the angle sharp. Tenth tergite (X.t.) acuminate, not excised at tip. Clasper (Cl, text-fig. 24) very broad ; ventral median lobe short, denticulate, projecting distad, but not narrowed into a long pointed process ; apex of clasper broad, truncate-dentate, when seen from above or below (text-figs. 24, 26) in aspect from inner side very broadly rounded and irregularly dentate

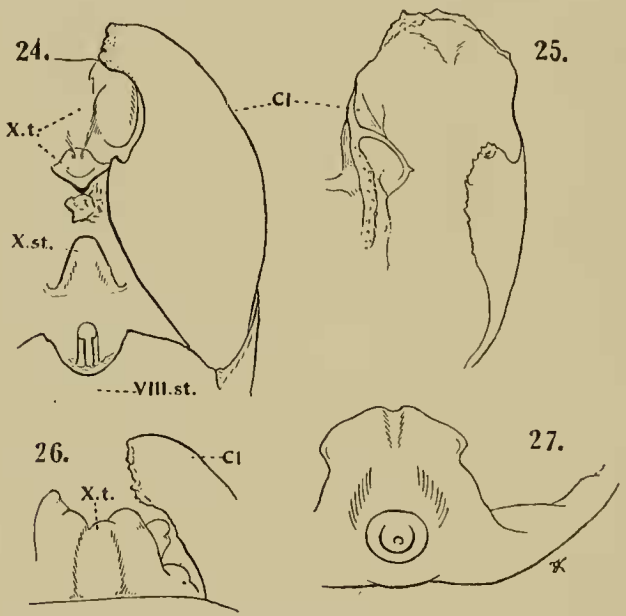


FIG. 24.—*Ludia corticea* ♂ ; genitalia, ventral aspect.
FIG. 25.—*L. corticea* ♂ ; clasper, inner side.
FIG. 26.—*L. corticea* ♂ ; tenth tergite and clasper, dorsal aspect.
FIG. 27.—*L. corticea* ♀ ; genital sclerite.

(text-fig. 25).——♀. Lobe of vaginal plate strongly projecting ; apex rounded with small median sinus ; sides sharply incurved before apex (text-fig. 27).

Neuration : SC^1 from stalk SC^{4+5}.

Early stages not known.

The species, which stands as yet isolated among the others, is easily recognised by the black subterminal blotches on fore- and hindwing.

2. **Ludia tessmanni** Strand (1911) (Pl. 1, figs. 8 ♂, 16 ♀).

♂♀. *Ludia tessmanni* Strand, *Iris*, xxv. p. 110 (1911) (Uelleburg, Spanish Guinea) ; id., *Arch. Naturg.* lxxviii. A. 6. p. 145. no. 14 (1912) (Uelleburg and Alen, Spanish Guinea, five pairs).

Ocellus very small in both sexes. Vitreous mark on forewing large in ♂.

In *Iris*, xxv., Strand mentions only the vitreous marks of this very distinct

species, but promises to give a full description in some other place. I have failed to find this description. The authorities of the Berlin Museum have very kindly come to my rescue by giving us in exchange a pair of paratypes, for which we are very grateful.

♂. Antenna with 13 or 14 segments quadripectinate and 17 or 18 dentate. Forewing entire, more strongly falcate than in any other *Ludia* known to me; lower cell-angle only 3 mm. distant from termen. General colouring a dark

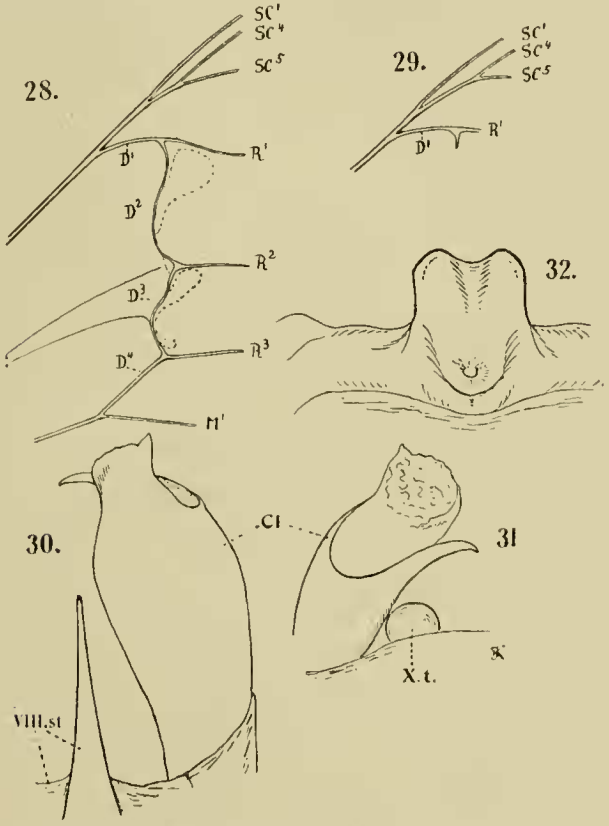


Fig. 28.—*Ludia tessmanni* ♀; neuration of left forewing.
Fig. 29.—*L. tessmanni* ♀; neuration of right forewing.
Fig. 30.—*L. tessmanni* ♂; eighth sternite and clasper.
Fig. 31.—*L. tessmanni* ♂; clasper, dorsal aspect.
Fig. 32.—*L. tessmanni* ♀; genital sclerite, ventral aspect.

mummy-brown, without the grey of *L. delegorguei*; the antemedian and postdiscal lines almost disappearing in the dark ground, their pale borders distinct and narrow, cinnamon; terminal margin and fringe likewise cinnamon except apical lobe. Vitreous spot very large.——Hindwing entire, termen very slightly elbowed at M¹ and incurved before anal angle; terminal margin and fringe narrowly cinnamon, tapering away at anal angle; black median band not separate from terminal area, the postdiscal line being practically absent, a trace of it indicated close to termen; proximal border of median band likewise indistinct. Ocellus very small, without white spot.

Underside drab mummy-brown. Forewing: red area extending about 2 mm. beyond base of M^2 and slightly entering cell; costal margin shaded with cinnamon; postdiscal line and terminal edge also cinnamon, the former running distad on apical lobe.——Hindwing almost uniform in colour, except for a narrow cinnamon terminal border.

♀. Antenna with 18 or 19 segments pectinated and 14 to 17 non-pectinated. In colouring similar to ♂; forewing much pervaded with cinnamon; antemedian line very oblique, not angulate below cell, its costal end almost separated off as an isolated spot; termen slightly undulate, deeply incurved below apex, very oblique posteriorly; postdiscal line as in ♂ ending at tornus, incurved below middle; vitreous mark not enlarged as in ♂, upper spot comma-shaped, lower one not larger than upper, but a little more curved, its upper end projecting slightly but distinctly; postdiscal line close to lower cell-angle as in ♂, more proximal than in the other species.——Hindwing: ocellus 2 × 2·3 mm. in the Guinea ♀ and not quite 3 × 4 in our (larger) specimen from the Upper Congo, with narrow black crescent and no white spot; orange scales partly with 3 or 4 short, blunt teeth, and partly with the apex entire and more or less rotundate.

Underside: Red area large, extending across cell to C and distally reaching base of M^1; terminal area broadly mummy-brown at margin and drab and cinnamon along postdiscal line. Scales of stridulation-area mostly strongly curved and sharply pointed, many angulate at highest point, also numerous small sinuate scales present.——Hindwing shaded with drab except at costal and terminal margins; transverse median line very oblique; postdiscal line indistinct, touching lower cell-angle or nearly.

Genitalia: ♂. Eighth sternite (VIII. st., text-fig. 30) with a very long, almost spiniform, median process. Clasper divided at apex into a broad and rounded, but at upper corner acuminate, ventral lobe and a curved, long, slender and pointed dorsal process (text-figs. 30, 31).——♀. Lobe of vaginal sclerite (text-fig. 32) strongly projecting, almost square, with the sides nearly straight, the apex strongly sinuate, and the angles rounded. The sclerite otherwise narrower than usual, strongly convex in a sagittal sense.

Neuration: SC^1 of forewing from stalk $SC^{4,5}$; discocellular D^2 as long as or longer than D^3, more or less curved in S-shape; M^1 rather more distal than usual (text-figs. 28, 29, taken from right and left forewing of Yakusu specimen).

Early stages not known.

Hab. Spanish Guinea; Upper Congo.

In the Tring Museum a pair of paratypes from Uelleburg, Spanish Guinea (Tessmann); a ♀ from Yakusu, Upper Congo (K. Smith).

In Mus. Berlin four pairs from Uelleburg.

3. **Ludia arguta** spec. nov. (Pl. 1, fig. 9 ♀).

♀♂. Grisescens, russata; linea postdiscali crenata, linea marginali russa vel nigra bene expressa tenui ornata, cilia pallida, ad venas russo vel nigro maculata.

Hab. Somaliland and British East Africa.

A small species, with the antennal pectinations long and numerous in both sexes, but particularly so in ♂.

♂. Antenna with 32 segments, of which 21 are quadripectinate; longest

branches as long as five segments; shaft tawny, branches ochraceous. Body russet, underside of abdomen paler, head and thorax above densely mixed with grey hair-scales, the non-dentate hair-scales lanceolate, narrow, none of them strongly dilated before apex.

Wings, *upperside:* Forewing shorter than in *L. delegorguei*, termen much more distinctly dentate; basal area grey irrorated with brown and shaded with cinnamon except costal margin and a line along the blackish antemedian line. This line with faint indications below cell of an excurved and an incurved angle. Median area olive-brown shaded with bistre, the median vein and the bases of the veins beyond upper cell-angle washed with cinnamon rufous. Postdiscal line crenulate, bordered by a prominent white line, and not ending quite so close to tornus as in *L. delegorguei*. Terminal area greyish cinnamon, with the usual grey costal cloud.——Hindwing costally longer than in *L. delegorguei*, costal margin less curved, termen indistinctly undulate, but rather distinctly elbowed at M^1, recalling *L. goniata*. Ocellus with white spot in sinus, diameter of orange ring shorter than distance from terminal margin, black border narrow except in cell. Postdiscal line bordered by a sharply defined white line.

Underside: Costal margin of forewing whitish grey spotted with brown; area around vitreous mark brown shaded with cinnamon; terminal area as above, but paler; postdiscal line white, continued to costal margin, outwardly shading off.——Hindwing densely shaded with creamy buff; costal margin whitish grey, spotted and irrorated with dark brown; postdiscal line not incurved below costa, its whitish border less conspicuous than on forewing. Cross-vein D^2 transverse, not oblique.

♀. Antenna darker than in ♂; 22 to 26 segments pectinate, 9 to 11 non-pectinate, apical branches of proximal pectinated segments represented by short projections. Body russet-brown, pronotum the same colour as mesonotum, with indication of a grey apical border.

Wings, *upperside:* Forewing more strongly dentate than in ♂, between the veins with distinct pale fringe-spots of variable size, usually the fringe more extended pale than brown, as is also the case in the hindwing. Basal area russet-grey, paler grey along antemedian line and at costa, not divided into a triangular pale costal area and a darker posterior area. Antemedian line deep russet, usually somewhat curved in S-shape in cell and slightly undulate or zigzag between cell and hindmargin, sometimes straight. Median band russet-brown, distally with or without grey scaling. Costal margin spotted with grey and brown from base to apex of cell. Veins above upper cell-angle slightly rufescent. Postdiscal line thin, conspicuously and regularly crenulate, more or less slightly accentuated upon the veins, with a narrow whitish grey outer border. Terminal area a little paler than base, with russet irroration which is condensed into a shadowy band along the whitish postdiscal line.——Hindwing dentate, tooth M^1 or likewise R^3 slightly longer than the others. Fringe as on forewing. Red area pinkish, as in ♂. Ocellus nearly as in *L. delegorguei*; the white spot placed on its outer portion sometimes barely vestigial. Median band pale from ocellus backwards, sometimes also pale on outer side of ocellus. Postdiscal line crenulate, nearly parallel with termen, ending as on forewing at some distance from anal angle; this line or its pale border often continued to costal margin. Terminal area nearly as on forewing, sometimes slightly pervaded with pink. A thin, rather sharply defined, marginal line as on forewing blackish brown.

Underside similar in colour to terminal area of upperside, almost unicolorous apart from red area. Cell of forewing and subcostal region beyond cell deeper brown. Costal margin spotted with whitish grey in both wings. Subterminal line of forewing more or less obsolescent posteriorly, not incurved below costa on hindwing. Red area entering cell and usually extending to base of M^1, variable in extent. Shadowy band outside postdiscal line distinct on both wings. Longitudinal brown cloud below costa of hindwing inconspicuous, sometimes absent; dark transverse band across cell of hindwing narrow. Marginal line as above.

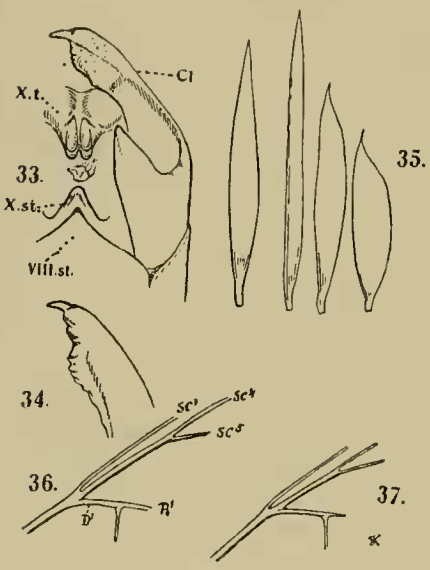


FIG. 33.—*Ludia arguta* ♂; genitalia, ventral aspect.
FIG. 34.—*L. arguta* ♂; apex of clasper, dorsal aspect.
FIG. 35.—*L. arguta* ♀; scales from stridulation-area.
FIG. 36.—*L. arguta* ♂; subcostals of forewing.
FIG. 37.—*L. arguta* ♀; subcostals of forewing.

Vitreous mark of forewing sometimes larger and sometimes thinner than in our figure (Pl. 1, fig. 9), the median projection usually shorter, sometimes distinctly dilated.

Scales of stridulation-area pale; nearly all narrow, pointed or bidentate, and hardly at all curved (text-fig. 35). Scales of fringe with three or more long, thin teeth.

Genitalia: ♂. Eighth sternite (VIII. st.) acuminate as in *L. orinoptena*, but shorter (text-fig. 33). Tenth tergite (X. t.) bilobate, each lobe divided transversely into an upper and a lower projection. Tenth sternite (X. st.) triangular, apex obtuse. Ventral lobe of clasper projecting anad, but without spiniform process; apical lobe irregularly dentate, ending with a claw-like process and being dilated proximally to this claw (text-figs. 33, 34).——♀. Vaginal sclerite less broad on the frontal side of the central cavity than in *L. delegorguei*; median lobe truncate-sinuate or rotundate.

Neuration: SC^1 of forewing from stalk of $SC^{4,5}$, usually near cell, rarely from upper cell-angle (text-figs. 36, 37).

Early stages not known.

Evidently two geographical forms:

(*a*) L. arguta arguta.

Grey tone prevalent on wings above and below; median band of forewing much shaded with grey; postdiscal line not strongly crenate, and the brown shadowy band in terminal area vestigial. Discocellular D^2 of hindwing much more transverse than longitudinal. Antenna of ♀ with 22 segments pectinate.

Hab. Mandera, Somaliland, S.W. of Berbera, April, September, and October (W. Feather), 1 ♂ (type) in Mus. Brit., 2 ♀♀ in Mus. Oxon.

(*b*) **L. arguta russa** subsp. nov. (Pl. 1, fig. 9 ♀).

♀. *Henucha hansali* ?, Butler, *Proc. Zool. Soc. Lond.* p. 430. no. 187 (1898) (Voi River, April).

♀. Body and median band of forewing russet-brown, much darker than in the previous form ; basal area and the undersurface of both wings (apart from red area) much shaded with russet-brown. Postdiscal line more conspicuously crenulate, and the shadowy brown band outside the grey border of the postdiscal line more pronounced, though rarely prominent. Antenna of ♀ with 24 to 26 segments pectinate. Second discocellular D^2 of hindwing less transverse.

Hab. British East Africa, only ♀♀ known.

In Mus. Tring 1 ♀ (type) from Kedai, April 1912 (W. Feather).

In Mus. Brit. 2 ♀♀ from Voi River and Juba River, and 11 ♀♀ (in coll. Adams) from Taveta.

In Mus. Oxon. 4 ♀♀ from Taveta, about 2,500 ft., May 1905 (Native coll.), presented by C. A. Wiggins.

4. **Ludia dentata** Hamps. (1891) (Pl. 1, fig. 5 ♀).

♀. *Ludia dentata* Hampson, *Ann. Mag. N.H.* (6). vii. p. 184 (1891) (Sabaki River).
♀. *Henucha dentata*, Sonthonnax, *Essai Classif. Lép.* vi. p. 43. no. 5. tab. 6. fig. 2 (1904) (fig. mala).
♂. *Ludia nyassana* Strand, *Iris*, xxv. pp. 111 and 114 (1911) (Langenburg, L. Nyassa).
♀. *Ludia luciphila* Strand, *l.c.* pp. 111 and 117 (1911) (Dar-es-Salaam).

Similar in its dark colouring to *L. orinoptena*, but easily recognised by the large greyish white patch or band situated posteriorly in the terminal area of the forewing beneath. Antenna of ♀ more strongly pectinate. Anal angle of ♂ strongly produced. No white scaling on orange ring.

♂. The ♂ described by Strand as *L. nyassana* I consider to belong to *L. dentata*. It is the only specimen of the ♂ I have seen. It differs much from the ♀, but hardly more so than the ♂♂ of *L. tessmanni* and *L. delegorguei* do from their respective ♀♀. At first sight this ♂, of which we give an outline sketch (text-fig. 38), resembles the ♂ of *L. tessmanni*, apart from the smaller size of the vitreous mark of the forewing and the clearly marked submarginal line of the hindwing. The apex of the forewing is strongly produced, and the outer margin of the hindwing markedly incurved posteriorly, the anal lobe being curved outwards as a short, blunt tail. The orange ring has no white scaling and is small. The grey submarginal patch on the underside of the forewing is much less white than in the ♀.

♀. Antenna with 35 to 38 segments, of which 26 to 29 (usually 27) are pectinate, 6 to 12 (usually 8) non-pectinate, longest branches longer than four segments. Pronotum not contrasting with mesonotum. Body, basal half of forewing, and abdominal area of hindwing with numerous oar-shaped white scales. Termen of both wings dentate ; apex of forewing and anal angle of hindwing prominent. Postdiscal line bordered by a conspicuous greyish white line, which is deeply incurved below centre of forewing. Basal area of forewing dark brown, more or less shaded with grey costally and along antemedian line. Orange ring thick, without white spot, or with only a faint trace of it. Abdominal margin of hindwing above with a red streak near base more or less distinct.

Red area of *underside* rather sharply defined, not entering cell, or only a small number of hairs in cell red ; postdiscal line abruptly bent costad at SC^4

(not at R^1), posteriorly accompanied by a broad greyish white, conspicuous but not sharply defined, band or patch.

Stridulation-area with two principal kinds of scales: short, broad, irregularly dentate scales flat on the wing, and narrow, obliquely erect ones which are more or less curved and mostly bidentate. The great majority of these long scales present the broad side to the eye, with both lateral edges so curved up that the scale appears channelled.

Genitalia: ♂. Eighth sternite with a rounded median lobe (text-fig. 39). Clasper, in ventral view, a large half-ring, its broad ventral process obliquely truncate; apical process also truncate-acuminate (the sketch taken *in situ*, without dissection).——♀. Vaginal sclerite narrower than in *L. delegorguei*; central cavity transverse; lobe very broad.

Neuration: SC^1 of forewing from stalk SC^4. SC^5 close to fork, rarely from SC^4. In one of our specimens SC^1 absent from left forewing.

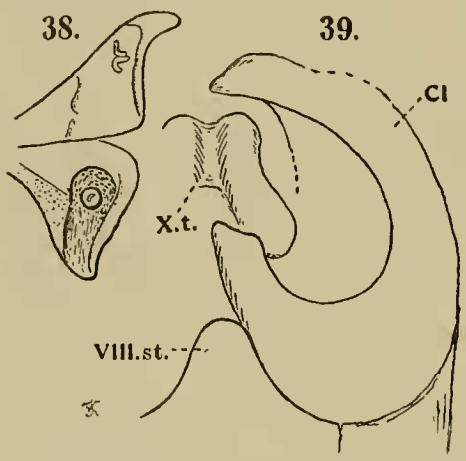


FIG. 38. *Ludia dentata* ♂.
FIG. 39. *L. dentata* ♂; genitalia, ventral aspect.

Early stages not known.

In the figure of the type published by Sonthonnax the vitreous mark of the right forewing is evidently taken from the left wing of the specimen. The outline of the hindwing is quite wrong.

Hab. British and ex-German East Africa.

In Mus. Tring from Kibwezi, April and May (W. Feather), 4 ♀♀; Pemba Island (E. Morland), 1 ♀; Bulwa, Usambara, 2 ♀♀; Dar-es-Salaam, 2 ♀♀; Itumba, 1 ♀; "German E. Africa," 2 ♀♀.

In Mus. Brit. 1 ♀ from Sabaki River (type).

In Mus. Oxon., from 15 miles west of Fort Hall, Kikuyu, 6,000 ft., May 1907, 1 ♀; Sagalla Mt. and Dabida Mt., 3,500 ft. and 3,700 ft., about 100 miles W.N.W. of Mombasa, 2 ♀♀; presented by K. St. A. Rogers.

In Mus. Berlin 1 ♂ from Langenburg, Lake Nyassa (type of *nyassana*); 1 ♀ from Dar-es-Salaam (type of *lueiphila*).

5. **Ludia hansali** Felder (1874).

♀. *Ludia hansali* Felder, *Reise Novara, Lep., Atlas*, p. 6. tab. 89. fig. 1 ♀ (1874) (Bogos).

Sexes less different in wing-shape than in *L. delegorguei*, to which the ♀ comes nearest in general appearance. Pronotum less pale than in that species, the basal and terminal areas of forewing above much shaded with brown and therefore not strongly contrasting with median band. Termen of both wings slightly undulate or even. Red area of hindwing of ♀ extending a little below cell; base of abdominal margin often with pink hairs. Vitreous mark of forewing usually very thin, often partly obsolete.

As in *L. delegorguei* the body bears numerous long grey oar-shaped scales,

the broad apex of which is truncate or slightly sinuate; similar scales in basal area of forewing. Scaling of median area of forewing, above, interspersed with numerous long pale scales, especially towards postdiscal line, which gives the wing the appearance of being more woolly than in *L. delegorguei*. On underside of forewing the scales in cell and on disc more deeply slit than usual, which, in the ♀, is especially noticeable near the area of stridulation.

Median band of hindwing above with a bluish tone, which often extends forward into the black border of the ocellus, either on the outside only or also in the cell. Ocellus as in *L. delegorguei*, with white spot, orange scales with three to six teeth, very few with two. On both wings, above and beneath, the grey border of the postdiscal band duller than in *L. delegorguei* and narrower; the postdiscal line slightly crenulate.

♂. Antenna with 15 or 16 segments quadripectinate and 16 or 17 non-pectinate, longest branches a little longer than four segments. Forewing broader than in *L. delegorguei*, apex less produced. Hindwing longer in costal half, therefore less narrow; costal margin and costal vein less curved. Fringe of both wings beneath dark, without distinct spots.

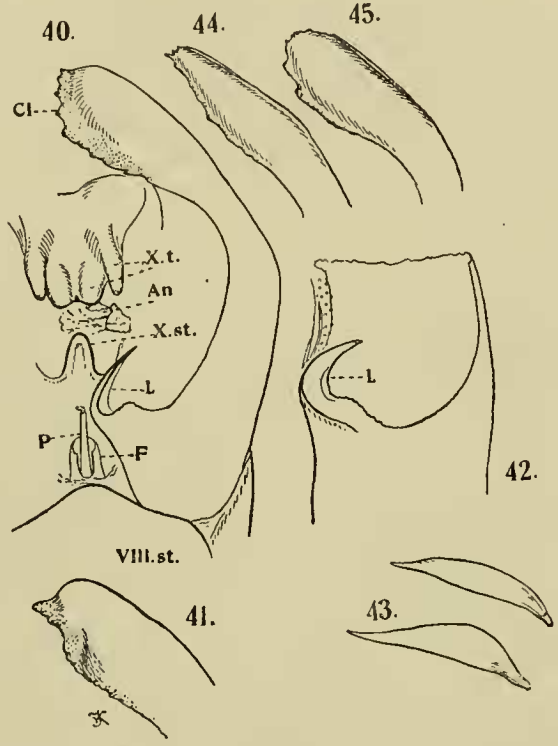


Fig. 40. *Ludia hansali tanganyikae* ♂; genitalia, ventral aspect.
Fig. 41. *L. h. tanganyikae* ♂; apex of clasper, dorsal aspect.
Fig. 42. *L. h. tanganyikae* ♂; ventral subbasal hook of clasper.
Fig. 43. *L. h. tanganyikae* ♀; scales from stridulation-area.
Fig. 44. *L. h. hansali* ♂; apex of clasper, ventral aspect.
Fig. 45. *L. h. eximia* ♂; apex of clasper, ventral aspect.

♀. Antenna with 24 to 26 segments pectinate, and 12 to 9 non-pectinate, longest branches as long as three and one-half or four segments; apical branches of pectinated segments vestigial, variable in length individually.

Stridulation-area of forewing beneath extending to M^2, rarely above it; the curved scales nearly all pointed (text-fig. 43); hardly any flat and dentate scales among them.

Genitalia: ♂. Median lobe of eighth sternite (text-fig. 40, VIII. st.) short, rounded, but distinctly narrowed apically, sometimes acuminate. Tenth tergite sinuate; dorsal pale projections long, reaching much beyond median process. Tenth sternite narrow. Clasper broad only in proximal fourth; this portion

with a long, curved, ventral hook, which is more or less bent into the cavity of the clasper (text-fig. 40); fig. 42 gives an externo-lateral view of the hook. Apex of clasper more or less widened, irregularly dentate (text-figs. 41, 44, 45).—— ♀. Vaginal sclerite with the median lobe rather narrow and distinctly sinuate; the portion of the segment connecting the vaginal sclerite with the previous segment strongly chitinised for a considerable distance.

Early stages not known.

Hab. Abyssinia westward to Lake Tanganyika and Nigeria; probably more widely distributed in tropical Africa.

We recognise here four subspecies, with a reservation. Whereas the Abyssinian race appears to be fairly distinct, we have some doubt about the other three really being different from one another. We separate two of them on account of slight distinctions in the ♂-claspers. As we have seen but few specimens, there is naturally a good deal of uncertainty.

(*a*) **L. hansali hansali** Feld. (1874).

♀. *Ludia hansali* Felder, *l.c.* (Bogos); Roths., *Nov. Zool.* ii. p. 50. no. 2 (1895).

♀. *Henucha* (!) *hansali*, Kirby, *Cat. Lep. Het.* p. 774. no. 3 (1892); Holland, in Don. Smith, *Through Unkn. Afr. Countr.* p. 412 (1897) (Gumbisa = Gambisa, about 40° lat., 40° long.—This insect ?); Sonth., *Essai Classif. Lép.* iv. p. 44. no. 6. tab. 6. fig. 8 ♀ (1904) ("♂" tab. 6. fig. 7, possibly taken from ♀ *L. arg. russa*; figure too bad for identification).

♂♀. Collar darker than in the following geographical forms, hardly at all contrasting with the mesothorax. Postdiscal line of forewing less excurved before hindmargin. Anal angle of hindwing more obtuse, the hindwing appearing more rounded. Antenna (broken off in our ♂) of ♀ with 27 segments pectinate and 7 non-pectinate, longest branches at least as long as four segments.

Genitalia of ♂ distinguished by the clasper being slenderer (text-fig. 44) and its proximal hook shorter and less curved than in the other races.

Hab. Abyssinia.

In Mus. Tring 1 ♀ from Bogos (Hansal; type), and 1 ♂ from Eli i. Marocko, Abyssinia (Alf. Kostlan), received from the Berlin Museum.

In Mus. Paris 1 ♀ from "Abyssinia" (Schimper).

In Mus. Berlin 1 ♂ from Eli i. Marocko (Alf. Kostlan).

(*b*) **L. hansali eximia** Roths. (1907).

Ludia delegorguei, Butler (nec Boisduval 1847, err. identif.), *Proc. Zool. Soc. Lond.* p. 84. no. 143 (1888) (Monbuttu, a much-worn pair).

♂. *Ludia eximia* Rothschild, *Ann. Mag. N.H.* (7). xx. p. 10. no. 21 (1907) (Kampala).

♀♂. Collar brownish grey, contrasting with the mesonotum. Postdiscal line of forewing, above, excurved before tornus; terminal area of hindwing narrower than in *L. h. hansali*.

Clasper of ♂ broader in apical half than in the preceding race (text-fig. 45). Median lobe of eighth sternite short and very obtuse in type, more acuminate in Mabera specimen.

Hab. Uganda.

In Mus. Tring 1 ♂ from Kampala (type; Stanley Tomkins); 1 ♀ from Kampala (Capt. Rattray).

In Mus. Brit. 1 ♀ from Monbuttu (Emin Pasha; the ♂ mentioned by Butler, *l.c.*, is not preserved in the collection); another ♀ from Mpuma, Uganda.

In coll. Joicey 1 ♂ from Mabera Forest (Jackson).

(*c*) **L. hansali taganyikae** Strand (1911) (Pl. 1, fig. 20 ♀).

♂. *Ludia tanganyikae* Strand, *Iris*, xxv. pp. 110 and 115 (1911) (Ujiji, Tanganyika).

♂♀. In colour like *L. h. eximia*. Clasper of ♂ (text-figs. 40, 41, 42) strongly convex before apex, the apical margin forming a kind of flattened, irregularly indented brim. In the two Nairobi-♂♂ examined the median lobe of the eighth sternite is obtuse, in the cotype from Ujiji more distinctly acuminate.

Antenna of ♀ with 24 to 26 segments pectinate, longest branches as long as three and a half segments. Friction-scales, cf. text-fig. 43.

Hab. British and ex-German East Africa.

In Mus. Tring 2 ♂♂, 3 ♀♀ from Nairobi, March and April 1905 (Jackson); 1 ♀ from Nairobi (Dr. van Someren); 1 ♂ (cotype) from Ujiji.

In Mus. Berlin 1 ♂ from Ujiji, N.E. Tanganyika.

(*d*) **L. hansali festiva** subsp. nov.

♂. Body and wings, both above and below, much more blackish brown than in the three previous subspecies, a dark slate-colour, paler in parts. Antenna with 15 segments quadripectinate and 14 non-pectinate, longest branches equalling four segments.

Wings, *upperside*: Forewing somewhat narrower than in *L. h. eximia* and *tanganyikae*, costa distally more curved, apex slightly more produced (but not so much as in ♂ *L. delegorguei*). Median band deep slate-colour, darkest anteriorly near discocellulars, distally shaded with slate-grey; basal area not much contrasting with median band. Postdiscal line angulate at M^2 as in *eximia* (costally much worn, but evidently not more curved than in *eximia*), bordered on outside with pinkish grey, which forms a narrow line shading off on distal side.

Underside slate-black, shaded with slate-grey, particularly on hindwing, which is almost unicolorous. Red area not extending so far into cell and along it as in *eximia* and *tanganyikae*. Costal margin of hindwing less curved; postdiscal line of hindwing undulate, not appreciably incurved anteriorly, much nearer to termen than to cell-apex. No distinct fringe-spots.

Genitalia as in *L. h. eximia*, but eighth sternite more acuminate, but not pointed as in *L. orinoptena*; broad dentate portion of apical lobe of clasper longer than in *eximia* and without the strong convexity of the clasper of *tanganyikae*.

Length of forewing: ♂ 27 mm.

Breadth of forewing: ♂ 12 mm.

Hab. Bauchi Plateau, N. Nigeria; 1 ♂ in Mus. Tring.

6. **Ludia delegorguei** Boisd. (1847).

♀. *Saturnia delegorguei* Boisduval, in Deleg., *Voy. Afr. Austr.* ii. p. 601. no. 152 (1847) (♀, Amazooloo).

Termen of both wings slightly undulate or practically even.

♂. Forewing narrow, falcate, about twice as long as broad. Terminal area

creamy buff, more or less shaded with cinnamon, more strongly contrasting with median band than does the basal area, which is more strongly shaded with grey. Postdiscal line ending in both wings close to or at tornus.——Hindwing triangular, with the costa strongly rounded. Red area extending to or near apical angle. Orange ocellus usually wider than its distance from termen, sometimes the diameter shorter; black-bordered vitreous crescent small, variable in size and shape, sometimes interrupted; black border of ocellus varying in width from 0·3 to 1 mm., occasionally produced costad, but not reaching the brown costal border.

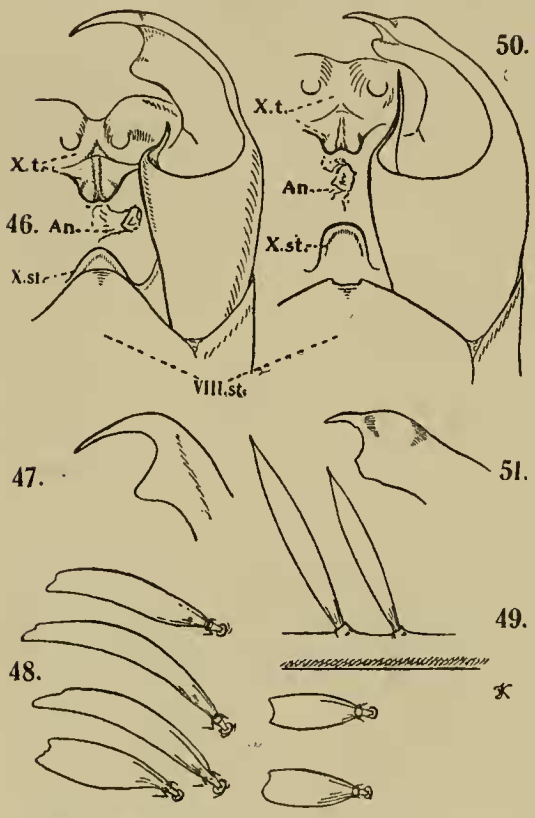


FIG. 46.—*Ludia delegorguei* ♂; genitalia, ventral aspect.
FIG. 47.—*L. delegorguei* ♂; apex of clasper, dorsal aspect.
FIG. 48.—*L. delegorguei* ♀; scales of stridulation-area.
FIG. 49.—*L. delegorguei* ♀; spiniform costal scales of hindwing.
FIG. 50.—*Ludia goniata* ♂; genitalia, ventral aspect.
FIG. 51.—*L. goniata* ♂; apex of clasper, dorsal aspect.

On *underside* the terminal border of forewing usually more strongly contrasting with disc than above, varying from being almost entirely creamy buff to being almost completely shaded with brown. Median area of forewing often with a distinct chestnut tint, sometimes nearly black. Fringe of both wings pale, with blackish or brown dots at the vein-ends.

♀. Antenna with 30 to 34 segments (apart from the two-scaled basal ones), 20 to 24 segments pectinate, 9 to 14 non-pectinate. On forewing, *above*, the triangular costal area from base to antemedian line, a stripe at costal margin beyond this line, and the terminal area along the postdiscal line bright grey. Postdiscal line incurved below middle, well separate from tornus (as is the case also in hindwing), but the distance from tornus individually variable. Antemedian line angulate on M and oxangulate or excurved on SM^1. As in ♂ the vitreous discocellular mark continuous, rarely the upper bar not reaching the lower crescent, both dilated at the ends or only at one end, the lower arm of the crescent variable in length, width, and curvature.——Red area of hindwing inconstant in size, extending to postdiscal line or more reduced, sometimes not quite reaching to upper cell-angle. Ocellus occasionally narrowed costad; white spot on its outer portion often very much reduced,

as happens frequently also in ♂; black border of ocellus varying in cell from 1 to 3 mm.

On *underside* the grey colour very variable in extent; usually there is a broad band along the postdiscal line, and the hindwing is often almost entirely shaded with grey, but in some specimens the grey colouring is nearly restricted to the mottling of the costal margins and to a thin, prominent, postdiscal band; in the latter case the blackish postdiscal band almost suppressed.

On *upperside* of forewing the teeth of the tri- and quadridentate upper scales along postdiscal line as long as or shorter than the scales are broad; teeth of lower scales short; long grey tridentate scales in posterior half of median band gradually widening apically, teeth about as long as the scale is broad. Stridulation-area on underside of forewing extending forward to M^2 or beyond, many of the scales, particularly between the submedian fold and submedian vein, short and flat, dentate or obliquely rounded, most of the narrow and curved scales truncate-sinuate, none or very few strongly curved (text-figs. 48, 49).

Genitalia: ♂. Eighth sternite (VIII. st., text-fig. 46) with a broad, rounded, but distinct, median lobe. Clasper broad from base to about centre, then narrow; the ventral median lobe produced distad into a long, spine-like process, which is slightly recurved ventrad; apical lobe of clasper abruptly narrowed to a spiniform black apical hook, which varies in length (text-figs. 46, 47).——♀. Vaginal sclerite broad, the median lobe large, rounded, with the apex truncate-sinuate, or rotundate; size of cavity variable, usually about as broad as long.

Neuration: SC^1 of forewing usually from stalk SC^{4+5}, as a rule branching off near fork, sometimes at bifurcation, often off SC^4 (text-fig. 5).

Early stages: Larva greenish white (yellowish in blown specimens); first stage shaded with black above, without definite pattern. Head in all stages black. From second stage a dorsal black stripe of elongate spots, which are widened behind the dorsal tubercles and are more or less joined together on the anterior and posterior segments; a spiracular stripe of small black spots, the spot in which the spiracle is situated larger than the others, which are transverse; above the legs another, blackish, stripe, which is more strongly marked in the last stage than in the earlier ones. Long plumose hairs (text-figs. 8, 9) white. Spines and short hairs of the colour of the ground on which they are placed, the pale spines nearly all with dark tips.——Pupa, cf. text-figs. 17, 18.——On *Microglossa mespilifolia*.

Hab. Cape Province and S.W. Africa north-eastwards to ex-German East Africa, probably distributed farther north.

Two subspecies:

(*a*) L. delegorguei delegorguei Boisd. (1847) (Pl. 1, fig. 12 ♂).

♀. *Saturnia delegorguei* Boisduval, *l.c.* (Amazooloo).

Saturnia delagorguei (!), Angas, *Kafirs Illustr.* tab. 30. fig. 13 ♀ (1849).

Saturnia (*Henucha* ? sic !) *delegorguei*, Westwood, *Proc. Zool. Soc. Lond.* p. 59. no. 30. tab. 10. fig. 4 ♂ (1849) (Amazooloo and Pt. Natal).

Henucha (!) *delegorguei*, Walker, *List Lep. Ins. B.M.* vi. p. 1332. no. 2 (1855) (Pt. Natal); Junod, *Bull. Soc. Neuchat. Sci. Nat.* xxvii. p. 241 (1899) (larva in winter on "*Mpachla*" tree; Delagoa Bay); Fawc., *Trans. Zool. Soc. Lond.* xvii. p. 172. tab. 6. fig. 36 larva (1903) (Durban, on *Microglossa mespilifolia*); Sonth., *Essai Classif. Lép.* iv. p. 42. no. 4. tab. 6. fig. 3 ♂ (1904) (Natal).

Saturnia dalagorguei (!), Monteiro, Delagoa Bay, p. 197 (1891) (larva).

Ludia delegorguei, Wallengren, *K. Sv. Vet. Akad. Handl.* (2). v. 4. p. 25 (1865); Kirby, *Cat. Lep. Het.* p. 774. no. 1 (1892) (Natal); Dist., *Ins. Transvaal.* i. p. 54. no. 3. tab. 5. fig. 8 ♂ (1903) (Johannesburg; "*Monbuttu*" error, = *eximia*); Strand, *Iris*, xxv. p. 111 (1911) (key to species); Packard, *Monogr. Bombyc. Moths*, iii. p. 150. tab. 31. fig. 7 larva (this spec.? or *goniata* ?), tab. 81. figs. 8 ♂, 8*a* ♀, tab. 111. figs. *c* ♂, *d* ♀, *e* pupa, *f* larva, *g* cocoon (1914) (Natal; fig. *d* is possibly ♀ *goniata*); O'Neil, *Ann. Durban Mus.* ii. p. 168 (1919) (Salisbury).

The only *Ludia* of which we have seen a large number of specimens. It is very variable in size as well as in coloration, the red areas above and below especially being quite inconstant in extent and intensity. The fringe bears pale spots in the ♂♂ and in most ♀♀, being unicolorous brownish black in other ♀♀.

In southern specimens the ventral median process of the ♂-clasper is shorter than the clasper is broad proximally to this process, in the ♂♂ from Rhodesia and Nyasaland, which are of a deep colour, the underside being almost black, the ventral process and the dorsal apical rounded lobe of the clasper are longer; intergradations occur.

Larva, see above.

Hab. Cape Province north-eastward to Rhodesia, Nyasaland, and ex-German East Africa.

A series from the Cape Province and Natal in Mus. Brit., Mus. Oxon., Mus. Tring, and other collections; but from the tropical districts we have seen only a few specimens, which possibly represent a tropical subspecies (cf. Pl. 1, fig. 13 ♂).

(*b*) **L. delegorguei vetusta** Strand (1911) (Pl. 1, fig. 21 ♀).

♀. *Ludia delegorguei*, Grünberg, in Schultze, *Forschungsreise Südafrika*, iv. I. p. 118 (1910) (Windhoek).
♀. *Ludia delegorguei* ab. *vetusta* Strand, *Iris*, xxv. p. 118 (1911) (Windhoek).

♂♀. A bright grey form. Sexes alike in colour. Body and median band of wings paler, terminal area of both wings less brown, and *underside* more shaded with grey than in *L. d. delegorguei*.

Hab. South-west Africa.

In Mus. Tring 2 ♂♂ and 5 ♀♀ from: Auos Mts., 7 km. south-west of Windhoek, 1,150 m.; Windhoek; Tsumeb, near Karibib.

In the Berlin Museum both sexes from Windhoek.

7. **Ludia goniata** Roths. (1907) (Pl. 1, figs. 4 ♀, 14 ♂).

Ludia goniata Rothschild, *Ann. Mag. N.H* (7). xx. p. 9. no. 20 (1907) (Natal; Grahamstown).

This species has long remained mixed up in collection with *L. delegorguei*, under which name we have also received it from Natal. Both sexes are easily differentiated from that species, the ♂ especially by the angulated termen of the hindwing, and the ♀ by the shorter pectination of the antenna and some detail in pattern.

♂. On an average larger than the ♂ of *L. delegorguei*. Branches of antenna shorter, the longest equalling two segments in length (three in *L. delegorguei*). Both wings dentate. Forewing broader and deeper brown; postdiscal line more or less scalloped, rarely even, not approaching tornus so closely as in *L. delegorguei*, narrowly bordered with pale clay-colour except towards apex; fringe-spots between the veins of this same colour, as are some ill-defined markings

placed near the fringes.——Hindwing very distinctly elbowed below middle; postdistal line nearly parallel with termen, excurved below centre of wing. Ocellus smaller than in *L. delegorguei*, less regularly rounded, orange ring thinner, black lunate pupil larger, its sinus narrower.

On *underside* the terminal area with but little pale scaling; red area extending to tornus.

♀. Antenna pectinated only to middle, 16 or 17 segments being pectinate, 17 to 19 non-pectinate, the branches, moreover, shorter than in *L. delegorguei*. Postdiscal line of forewing hardly at all incurved below middle, being straighter than in the preceding species; the grey colouring in costal area and along postdiscal line less pure, being shaded with brown; between postdiscal line and termen on both wings an ill-defined brown band.

On *underside* the black postdiscal line distinct on both wings; general coloration deeper brown than in *L. delegorguei*, the grey scaling almost confined to the outside border of the postdiscal line.

Genitalia: ♂. Eighth sternite short, rounded, its apex sinuate (text-fig. 50). Apical lobe of tenth sternite (X.st.) very little narrowed apically. Clasper broad to middle; the median ventral lobe produced into a long, pointed, and recurved process; apical claw shorter than in *L. d. delegorguei*, and the subapical lobe of the dorsal margin (text-fig. 51) less projecting.——♀. Vaginal sclerite essentially as in *L. delegorguei*.

Early stages not known.

Hab. Cape Province and Natal, probably more widely distributed.

In Mus. Tring 7 ♂♂, 4 ♀♀ from Namaqualand, Durban (Leigh), and "Natal."

In Mus. Brit. 2 ♂♂, 2 ♀♀ from Grahamstown.

Also a small series in coll. J. J. Joicey and Mus. Berlin.

8. **Ludia pupillata** Strand (1911).

♀. *Ludia pupillata* Strand, *Iris*, xxv. p. 116 (1911) (Antottos, Abyssinia).

Only one specimen known, a ♀ in the Berlin Museum, without antennae and abdomen. Not unlike *L. deleg. delegorguei*, but the forewing more uniform in colour, the antemedian band broader and almost evenly curved, the postdiscal line non-dentate, termen undulate. Hindwing with marginal tooth at R^1 and M^1; orange spot slightly longer (in basi-distal direction) than broad, not reniform, its distal margin nearly straight, pupil small, hardly at all curved; white scaling in outer portion of orange spot inconspicuous; black median band narrow behind, about half as wide at abdominal margin as in front of orange ocellus. Postdiscal line in both wings as widely separate from tornus as in *L. delegorguei*.

Hab. Abyssinia.

In Mus. Berlin 1 ♀ from below Antottos, Abyssinia, 10.vi.1907, at light (Kostlan).

9. **Ludia orinoptena** Karsch (1893).

♂♀. *Ludia orinoptena* Karsch, *Berl. Ent. Zeits.* xxxvii. p. 504. no. 21. tab. 20. fig. 2 ♀ (1893) (Buea, Camerun).

♂♀. A deep-coloured species. Pronotum and costal area of forewing (above) more or less isabella colour, not so much contrasting with median band as in ♀♀ *L. delegorguei* and *L. goniata*; terminal area nearly as dark as median band;

pale border of postdiscal line narrow. Upper vitreous bar of forewing nearly always pointed behind and usually not reaching the arcuate vitreous spot. Orange ocellus very variable, always with white spot.

♂. Antenna quadripectinate to middle (14 to 17 segments). Wings in shape recalling those of *L. goniata*, dentate.

♀. Antenna with 35 or 36 segments of which 17 to 19 are pectinate. Termen of wings undulate or entire.——On *underside* the red area extends far into cell, usually to subcosta ; on both wings a well-marked terminal band mummy-brown like centre of forewing, in fresh specimens shaded with bright tawny olive ; between this band and postdiscal line a fawn or drab band ; outer portion of median band of forewing and nearly the whole hindwing (with the exception of costal and subcostal areas and a broad line across cell) shaded with drab or fawn.—Most of the scales of the stridulation-patch long, narrow, pointed.

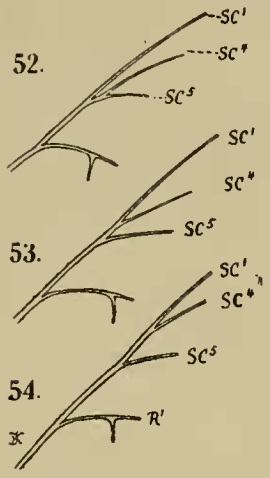


FIG. 52.—*Ludia syngena* ♀; subcostals of forewing.
FIG. 53.—*Ludia orin. orinoptena* ♀; subcostals of forewing.
FIG. 54. — *Ludia orin. timbobrunnea* ♀; subcostals of forewing.

Genitalia : ♂. Eighth sternite (VIII. st., text-fig. 55) medianly produced into a long, triangular, pointed lobe. Tenth tergite sinuate ; tenth sternite short. Clasper (Cl) broad from base to beyond middle ; the median ventral lobe irregularly denticulate, without a spiniform process ; apical lobe of clasper twisted, widened before end, variable individually (text-figs. 56–58).——♀. Vaginal sclerite broad (in a fronti-anal sense), at the side of the median lobe much more than half as wide as in the centre (measured from apical margin of lobe to base of sclerite), the median lobe not projecting so much beyond the lateral apical margin of the sclerite as in the allied species *L. goniata* and *L. obscura*, rounded at apex or sinuate.

Neuration : SC^1 of forewing branching off SC^4 (*i.e.* beyond fork) in all specimens examined (twenty-five), its distance from point of origin of SC^5 very variable (text-figs. 53, Adamaua, 54, Langenburg).

Early stages, see under subspecies.

Hab. Adamaua and Camerun to Angola, Rhodesia, Nyasaland, and Uganda.

The species varies very much individually in size, colour, and pattern. The division of the species into a western and an eastern subspecies must be considered as being preliminary, the distinctions adduced to be taken *cum grano salis*.

(*a*) **L. orinoptena limbobrunnea** Strand (1912).

♂♀. *Ludia limbobrunnea* Strand, *Mitt. Zool. Mus. Berlin*, v. p. 299. no. 123. text-fig. ♂ (1911) (N. Langenburg, Nyasa).

♂♀. Vitreous spots of forewing usually contiguous.
♂. Hindwing nearly as much elbowed as in *L. goniata*.
First stage of larva described on p. 226.
Hab. Rhodesia and Nyasaland northward to Uganda.

In Mus. Tring from Langenburg, Nyasa, March 1906, 1 ♀; Entebbe, Uganda, 3 ♂♂ and 1 ♀.

In Mus. Brit. from Mlanje Plateau, Nyasaland (Neave), 3 ♀♀; Kampala, Uganda, 1 ♀. In Mus. Berlin from Langenburg, Nyasa.

In Mus. J. J. Joicey, from Shigudara, Imtali, Rhodesia, 1 ♂; Toro, 1 ♀.

(*b*) **L. orinoptena orinoptena** Karsch (1893) (Pl. 1, figs. 1 ♂, 2 ♀).

♂. *Ludia orinoptena* Karsch, *l.c.* (Camerun); Strand, *Iris*, xxv. p. 111 (1911).
Ludia dentata, Aurivillius (nec Hamps. 1891, err. identif.), *Arkiv Zool.* ii. 4. p. 14. no. 43 (1904) (Camerun); Schultze, *Arch. Naturg.* lxxx. A. 1. p. 162. no. 24 (1914) (larva, Camerun).
Ludia orinoptera (!), Aurivillius, *l.c.* sub. no. 43 (1904).

♂♀. The upper vitreous spot of the forewing usually separated from the lower spot, often reduced to a short comma. Ocellus very variable; the orange ring often as narrow as in *L. obscura* and the black correspondingly large, which is particularly frequent in ♀♀ from the Congo.

♂. Hindwing more triangular than in the preceding form, dentate, but not so distinctly elbowed.

Larva described by Schultze (*l.c.*) as light parrot-green; stigmata black; tubercles grey; head, all legs, and a narrow border around each stigma dark brown. Tubercles with black spines and some long grey hairs. Body covered with soft hair, which is whitish except on first three segments, where it is golden yellow.

Food-plant: larva found on a climbing, aromatic *Labiate* with small flowers, fed up with another aromatic Labiate of the genus *Ocimum*.

Hab. Adamaua to Angola and Upper Congo.

In Mus. Tring from: Adamaua, 1 ♀; Lolodorf, Camerun, 1 ♂; Camerun, 1 ♀; Yakusu and Bopoto, Upper Congo (Forfeitt and K. Smith), 9 ♀♀.

In Mus. Brit. from: Bihé, Angola, 1 ♂ (coll. Adams).

In Mus. J. J. Joicey from: Bitje, Ja River, Camerun (Bates), 1 ♂ and 2 ♀♀; Mongoma Lobah, Camerun, 1 ♀.

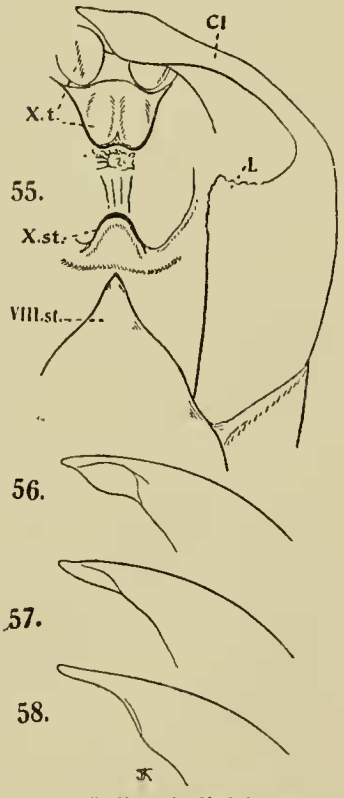


Fig. 55.—*Ludia orin. limbobrunnea* ♂; genitalia, ventral aspect.
Fig. 56–8.—*L. orin. limbobrunnea*, apex of clasper, dorsal aspect; three specimens from Entebbe.

10. **Ludia syngena** spec. nov. (Pl. 1, fig. 3 ♀).

♀. Similar to *L. orinoptena*. Antenna with 31 segments, of which 18 are pectinate, *i.e.* a larger number than in *L. orinoptena*. Subcostal SC^1 of forewing from stalk of $SC^{4,5}$, not from SC^4 (text-fig. 52). Lobe of vaginal plate broad, rounded, less projecting than in *L. orinoptena*.

Antemedian line of forewing rectangular upon M and again upon (SM^1). Upper vitreous spot strongly tapering behind, barely touching second spot; the latter anteriorly projecting further distad than in any other *Ludia* known to us, the projecting lobe longer than its distance from the postdiscal line. Grey border of postdiscal line narrow, ending closer to tornus than in *L. orinoptena*. Termen of both wings non-dentate, anal angle of hindwing projecting.

Hab. Bathurst, Gambia; 1 ♀ in Mus. Tring.

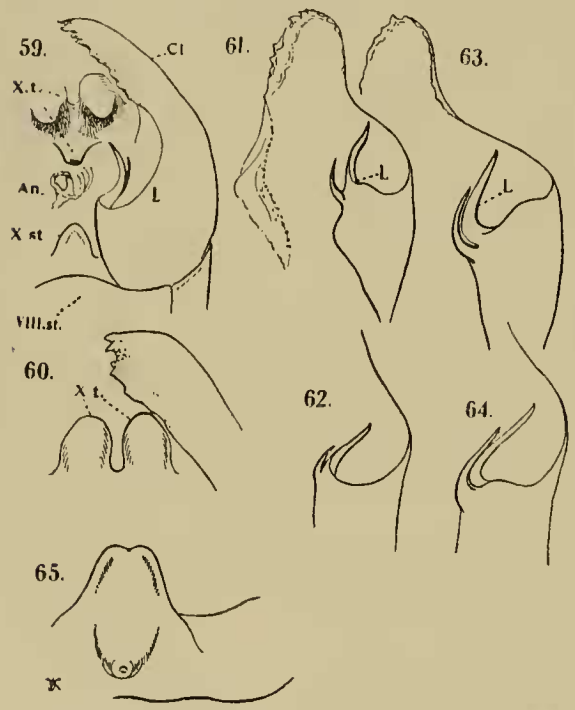


FIG. 59.—*Ludia obscura apora* ♂; genitalia, ventral aspect.
FIG. 60.—*L. o. apora* ♂; humps of X.t. and apex of clasper, dorsal aspect.
FIG. 61.—*L. o. opora* ♂; clasper from inside.
FIG. 62.—*L. o. apora* ♂; ventral processes of clasper, externo-lateral aspect.
FIG. 63.—*L. o. laeta* ♂; clasper from inside.
FIG. 64.—*L. o. laeta* ♂; ventral processes of clasper, externo-lateral aspect.
FIG. 65.—*L. o. obscura* ♀; genital sclerite.

11. **Ludia obscura** Auriv. (1893).

♀. *Ludia obscura* Aurivillius, *Ent. Tidskr.* xiv. p. 201, no. 4 (1893) (Camerun).

♂♀. Orange ring thin, the black pupil therefore large, round, sinuate on outer side, with a thin, curved, vitreous line. Grey border of postdiscal line reduced to form a sharply defined narrow line. Red colour of hindwing often more or less completely suppressed. Clasper of ♂ differing from that of all other species in the ventral lobe bearing two pointed processes (text-figs. 59, 61–64).

♂. Antenna of 30 to 33 segments, only 13 or 14 of which are quadripectinate, 17 to 20 being non-pectinate. Wings dentate-undulate. Antemedian line of forewing rectangulate below cell; vitreous spots contiguous, thinner than in *L. delegorguei*-♂, the lower one sometimes partly obliterated; postdiscal line ending close to tornus.—— Hindwing triangular, apex less rounded than in *L. delegorguei*-♂, angulate, termen on the whole straighter; diameter of orange ring shorter than distance from termen; postdiscal line converging with termen, ending close to tornus.

On *underside* both wings with a fairly sharply defined brown terminal band, which is separated from the postdiscal line by a pale band varying from fawn-colour to vinaceous cinnamon.

♀. Antenna with 33 to 38 segments, of which 24 to 27 are bipectinate, 9 to

11 non-pectinate. Colour and markings as in ♂. In both wings termen undulate, and postdiscal line ending close to tornus.

Genitalia: ♂. Eighth sternite (VIII. st., text-fig. 59) medianly very slightly produced and strongly rounded. Apical process of tenth tergite (X. t.) entire, not sinuate; dorsal humps large. Clasper broad to one-third (text-figs. 59–64), the ventral lobe with two curved, pointed processes, of which the lower one is the longer; apex of clasper broad, dentate.——♀. Median lobe of vaginal sclerite strongly projecting, slightly sinuate or rounded at apex (text-fig. 65).

Neuration: SC^1 of forewing most often branching off exactly opposite SC^5 or close before or close after SC^5, in some of the large ♂♂ off SC^4 at some distance from point of origin of SC^5.

Larva of *L. o. obscura*, according to Sjöstedt, greenish white, anteriorly with four dark tufts, a dorsal line, a lateral one, and the underside blackish, legs paler. In some specimens without dark lines the anterior tufts not black.

Hab. Camerun to Ivory Coast.

The specimens we have seen apparently represent four subspecies.

(*a*) **L. obscura obscura** Auriv. (1893).

♀. *Ludia obscura* Aurivillius, *l.c.* (Camerun); id., *Arkiv Zool.* ii. 4. p. 14. no. 44. text-fig. 20 ♀ (1904) (descr. of larva).
Ludia orinoptena, Strand. *Iris*, xxiv. p. 189 (1910) ("*obscura* = *orinoptena*" falso).
Ludia sopponis Strand, *Archiv Naturg.* lxxx. A. 1. p. 45 (1914) (Soppo, Camerun).

♂ not known.

♀. Red area of hindwing above almost completely obsolete. Termen of both wings almost entire, being very slightly undulate; grey postdiscal line of forewing (above) not prominent; tornus of forewing oblique, but distinctly angulate. Scales of stridulation-area truncate or sinuate, hardly any pointed.

Hab. Camerun and Niger Delta.

In Mus. Tring 1 ♀ from Warri, Niger Delta, April 1897 (Dr. Roth).

Also 1 ♀ in Entom. Mus. Dahlem (type of *sopponis*).

(*b*) **L. obscura apora** subsp. nov. (Pl. 1, figs. 10 ♂, 17 ♀).

♂♀. Red area of upperside of hindwing vestigial. Postdiscal pale line of forewing sharply defined and prominent.

♂. Postdiscal line of hindwing reaching margin at anal angle. Upper median ventral process of clasper (text-figs. 59, 61) short and well separated from second process.

♀. On underside of forewing the proximal portion of the brown terminal band deeper in tone than the marginal portion, forming a diffuse blackish abbreviated band between postdiscal line and termen. Scales of stridulation-area as in the previous form. Termen of both wings moderately dentate. Tornus of forewing much more oblique than in *L. o. obscura*.

Hab. Nigeria.

In Mus. Tring 1 ♂ and 4 ♀♀ labelled "Nigeria," evidently from up the river. Three specimens bear an additional label, stating that they emerged in July, October, and November respectively.

The distinction in the clasper of the ♂ may not be constant.

(*c*) **L. obscura intermedia** subsp. nov.

♂♀. Red area of hindwing varying from being obsolescent to being nearly as well developed (in some of the ♀♀) as in the next subspecies.

♂. Like *L. o. apora*. Clasper differs in the two median ventral processes being contiguous, as in the following race; red area of upperside much reduced, fairly distinct from base to median band.

♀. Tornus of forewing as oblique as in the previous form; terminal band of underside of forewing likewise as in *L. o. apora*. Scales of stridulation-area as before, but a portion of them pointed.

Hab. Lagos.

In Mus. Oxon 3 ♂♂ and 5 ♀♀ from Lagos district, bred by W. A. Lamborn, in June, August, October, and November.

(*d*) **L. obscura laeta** subsp. nov. (Pl. 1, fig. 18 ♂).

♂♀. Red area of hindwing clearly defined and about as large as in *L. delegorguei*, somewhat shaded with brown posteriorly in cell. Costal margin and veins of forewing on the whole more copiously irrorated with grey than in the previous races.

♂. Very variable in size, some specimens not being larger than the ♂ of *L. o. apora* here figured (Pl. 1, fig. 10). Clasper (text-figs. 63, 64) as in *L. o. intermedia*. Postdiscal line of hindwing posteriorly remaining separate from margin.

♀. Terminal band of forewing below practically of a uniform dark colour. A large proportion of the stridulation scales pointed.

Hab. Gold Coast and Ivory Coast.

In Mus. Tring from Wassaw district, 45 miles inland from Sekondi, Gold Coast, 2 ♂♂; Kumasi, Gold Coast, November 1909, 1 ♂, *type*; Dimbokra, Ivory Coast (J. Dyot), 1 ♂.

In Mus. Brit. from Bibianaha, Gold Coast (H. G. F. Spurrell), 5 ♂♂; Aburi, 1 ♀.

In Mus. J. J. Joicey, from Sekondi, Gold Coast, 1 large ♂.

In coll. J. H. Watson, from Ivory Coast, two pairs.

Vegetia gen. nov.

Heniocha, Geyer (nec Hübner, 1822 ?), in Hübn., *Exot. Schmett.* iii. tab. 44 (1831) (indescr.).
Saturnia (*Henucha* !), Westwood, *Proc. Zool. Soc.* p. 59 (1849) (laps. cal.; indescr.).
Henucha, Walker, *List Lep. Ins. B.M.* vi. p. 1331 (1855) (name ex Westwood, *l.c.*; description of genus taken from *Ludia delegorguei*); Kirby, *Cat. Lep. Het.* p. 774 (1892); Roths., *Nov. Zool.* ii. p. 50 (1895); Sonth., *Essai Classif. Lép.* iv. p. 40 (1904); Auriv., *Arkiv Zool.* ii. 4. p. 21 (1904); Strand, *Iris*, xxiv. p. 188 (1910) ("does not belong to the *Ludiinae*" false); Packard, *Monogr. Bombyc. Moths*, iii. p. 148 (1914).

Westwood quotes "*Phalaena* (*Henucha*) Hübner," but Hübner (as well as Geyer) wrote *Heniocha*. Westwood did not intend to propose a new generic name, but accidentally misspelt a name originally given by Hübner to the Saturnian figured by Cramer (*Pap. Exot.* iii. tab. 250. fig. A) as *Phalaena Attacus apollonia*, and he gives no description of "*Henucha*."

Walker (1855) quotes "*Henucha*, Hübn. Exot. Schmett." and "*Saturnia* (*Henucha*) Westw.," and places in *Henucha* three species: *grimmia*, *delegorguei*,

and *smilax*, the description of the genus evidently being taken from *delegorguei* (cf. antennae).

Neither Westwood nor Walker knew *grimmia* except from the figure in Hübner III.

"*Henucha*," clearly being an accidental distortion of *Heniocha*, is a synonym of it and cannot be employed as a separate generic term.

♂♀. A generibus *Ludia* et *Holocera* dictis epiphysi protibiali atque torsorum pulvillo obliteratis distinguenda.

Genotypus: Species identified as *Ludia dewitzi* Maass. (1885).

♂♀. Frons broader than the eye is high transversely. Genal groove large and deep. Mouth-parts vestigial, as in *Ludia*. Antenna in ♂ quadripectinate to four-fifths, shaft of pectinated segments broad; in ♀ bipectinate or simple, two or three proximal segments cylindrical, distal ones slightly compressed (text-fig. 67), the others broad, flattened (text-fig. 68), and each produced on inner and outer sides, either into a broad, obtuse cone which bears cilia and a short seta (sometimes two), or into a short branch about as long as a segment (text-fig. 70). Foretibia without epiphysis in both sexes. Tarsi spined beneath, as in *Ludia*; in ♀ the sole of the fifth foretarsal segment non-scaled, but studded with dispersed S-shaped sensory hairs. Pulvillus without the usual dark apical pad, only the pale basal portion of the pulvillus being preserved as a more or less triangular flap. Paronychium short and broad.

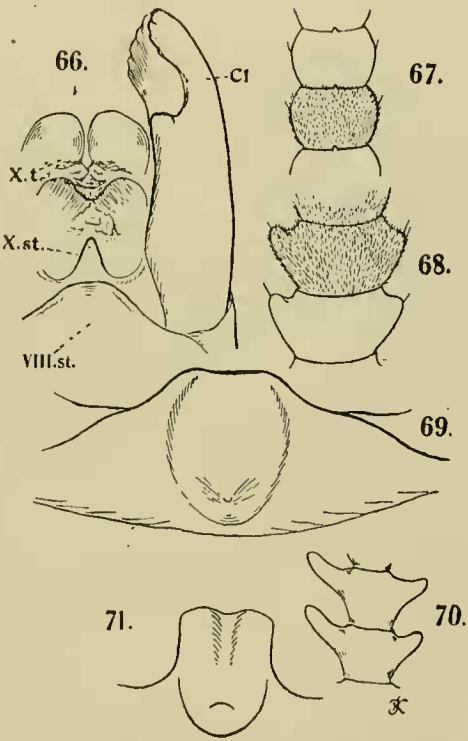


Fig. 66.—*Vegetia dewitzi* ♂; genitalia, ventral aspect.
Fig. 67.—Segment 23 of antenna of *V. dewitzi* ♀; ventral aspect.
Fig. 68.—Segment 10 of antenna of *V. dewitzi* ♀; ventral aspect.
Fig. 69.—Genital sclerite of *V. dewitzi* ♀; ventral aspect.
Fig. 70.—Pectinate segments of antenna of *V. ducalis* ♀; ventral aspect.
Fig. 71.—Lobe of genital sclerite of *V. ducalis* ♀; ventral aspect.

Termen of forewing not incurved, apex not produced as a lobe. Both wings above and below with a vitreous discocellular ring, which is usually open distally.

Body with numerous, white, long-stalked scales, which are broad at the end and truncate or truncate-rotundate, with the dentition indistinct; similar scales on the wings.

Neuration: Forewing as in *Ludia* with 3 subcostals, all beyond cell on a long stalk, SC^1 off SC^4; discocellular D^2 much shorter than D^3, whereas in

Ludia and *Holocera* these two cross-veins are practically equal in length (*i.e.* R^3 = vein 5 from middle).

No organ of stridulation in ♀.

Genitalia similar to those of *Ludia*.

Early stages not known.

Geyer as well as Maassen erroneously figures the ♀ with long-pectinated antenna. Packard, who had 2 ♂♂ and a ♀, describes the antenna of the ♂ only. Sonthonnax figures the antenna of the ♀ as pectinated to the tip, but the figure is grotesque. The ♀♀ I have seen have the antennae as described above (text-figs. 67, 68, 70).

Three species from the Cape Province.

1. **Vegetia dewitzi** Maass. (1885).

♀. *Ludia dewitzi* Maassen, *Beitr. Schmett.* figs. 90, 91 ♀ (1885) (Cape, Mus. Berol.).

Henucha dewitzi, Kirby, *Cat. Lep. Het.* p. 774. no. 2 (1892) (Cape); Roths., *Nov. Zool.* ii. p. 50 (1895); Sonth., *Essai Classif. Lép.* iv. p. 41. no. 2. tab. 6. fig. 4 ♂, 5 ♀ (1904) (Cape); Pack., *Monogr. Bombyc. Moths*, iii. p. 148 (1914) (Capo).

♂♀. Forewing with three creamy-buff bands, antemedian, postdiscal, and terminal. Hindwing red from base to ocellus (♀) or to terminal area (♂), with two creamy-buff bands, antemedian and terminal, the former almost entirely shaded over with red (♂) or only anteriorly (♀). Vitreous ring in both wings open or closed. Frons pale yellow or creamy, with the sides pink.

In ♂ the thorax streaked and the abdomen ringed with creamy buff. Termen of forewing less convex than in ♀.

Genitalia: ♂. Eighth abdominal sternite (text-fig. 66) with a rotundate-truncate median lobe (which is not quite symmetrical in our only ♂). Tenth tergite with two large pale dorsal swellings; apical process black, short, obtuse, on its upperside before tip a double hump. Tenth sternite triangular. Clasper sinuate ventrally beyond middle, the lobe proximal to the sinus triangular; apical lobe broad, somewhat spathulate when viewed from inner side, with the apex obliquely truncate and irregularly scalloped (text-fig. 66). Penis-funnel short, broad, sinuate ventrally. Penis-sheath slender.——♀. Genital sclerite (text-fig. 69) in centre less than twice as wide (in fronti-anal sense) as at the side of the median lobe. This lobe truncate-sinuate; the cavity extending to near anterior margin of sclerite.

Hab. Cape Province.

In Mus. Tring 1 ♂ and 3 ♀♀ from "South Africa."

In Mus. Brit. 1 ♂ from Grahamstown and 1 ♀ from Deelfontein.

In Mus. Berlin 1 ♀ (type of *dewitzi*, without antennae) from the Cape.

2. **Vegetia grimmia** Geyer (1831).

Heniocha grimmia Geyer, in Hübn., *Samml. Exot. Schmett.* iii. tab. 44. figs. 3, 4 (1831) (Afr. mer.).

Saturnia (*Henucha* !) *grimmia*, Westwood, *Proc. Zool. Soc. Lond.* p. 59 (1849) ("not seen").

Henucha grimmia, Walker, *List Lep. Ins. B.M.* vi. p. 1331. no. 1 (1855) ("not seen"); Kirby, *Cat. Lep. Het.* p. 774. no. 2 (1892); Roths., *Nov. Zool.* ii. p. 50 (1895); Sonth., *Essai Classif. Lép.* iv. p. 42. no. 3. tab. 6. fig. 6 (1904) ("not seen"); Strand, *Iris*, xxiv. p. 188 (1910) ("a bad specimen in Mus. Berol.").

A specimen in the Staudinger collection (Mus. Berlin) from Herrich-Schäffer's collection. It agrees so well with Geyer's figure that one might be inclined to regard it as the specimen from which the figure was drawn.

♀. Larger than *V. dewitzi*. Bands broader, antemedian one consisting of two large half-moons, the postdiscal band of well-separated lunules, and the terminal band, which is yellow in both wings, is much more strongly broken up into spots than in *V. dewitzi*. Vitreous halfring of forewing with a triangular costad enlargement; on hindwing, above, a slight tint of yellow at the basal side of the black ring, and on the underside a diffuse red smear in cell, as in Geyer's figure. Head dark, with a trace of red. Collar white. Antenna with 37 segments, 25 shortly bipectinate, the others non-pectinate. Process of vaginal plate as in the following species, but shorter and broader; much less rounded than in *V. dewitzi*.

Hab. "South Africa."

One ♀ in Mus. Berlin.

3. **Vegetia ducalis** spec. nov.

♀. *V. grimmiae* similis, minor, areis rubris fere nullis facile distinguenda.

♀. Head like abdomen, blackish mixed with grey. Collar white. Antenna with 35 segments, of which the third to the twenty-fifth are bipectinate, the longest branches being about as long as a segment (text-fig. 70). Antemedian band of forewing broken into two angulate spots, the upper less than half the size of the second; postdiscal band nearly as in *V. grimmia*, but rather narrower; marginal spots of both wings white with a faint tint of yellow, broadly separated, particularly on forewing. Hindwing above and forewing below with just a trace of red, while in the preceding two species the red areas are large and very conspicuous. Median lobe of vaginal plate (text-fig. 71) almost square, about as long as broad, the sides slightly incurved; the apical margin incurved in centre, excurved laterally, with distinct lateral angle.

Hab. Cape of Good Hope; 1 ♀ in Mus. Berlin.

4. Genus: **Goodia** Holland (1893).—Typus: *nubilata*.

Saturnia, Dewitz, *Nova Acta Leop. Carol. Ak. Naturf.* xlii. 2. p. 70 (1881).

Saturnia (?), Holland, in Donalds. Smith, *Through Unknown Afr. Countr.* p. 413 (1897).

Goodia Holland, *Ent. News*, p. 178 (1893) (type: *G. nubilata*); id., *Ann. Mag. N.H.* (6). xii. p. 25 (1893) (prior to *Orthogonioptilum*); Sonth., *Essai Classif. Lép.* iv. p. 44 (1904) (no descr. of genus); Auriv., *Arkiv Zool.* ii. 4. p. 21 (1904) (type: "*nebulata*," recte *nubilata*; venation; = *Campimoptilum*); Strand, *Iris*, xxiv. p. 188 (1910) (difference from *Orthogonioptilum*); Pack., *Monogr. Bombyc. Moths*, iii. p. 11 (1914) (synon. partim).

Tagoropsis, Karsch (nec Felder, 1874), *Berlin. Ent. Zeits.* xxxvii. p. 500 (1893, May).

Orthogonioptilum Karsch, *Ent. Nachr.* xxii. p. 247 (1896) (= *Goodia*, error).

Campinoptilum Karsch, *l.c.* p. 248 (1896, August) (type: "*kunzei*," recte *kuntzei*); Strand, *Iris*, xxiv. p. 187 (1910) (enumer. of species).

Lasioptila Kirby, *Ann. Mag. N.H.* (6). xviii. p. 386 (1896, November) (type: *ansorgei* = *kuntzei*).

In the ♂-antenna the apical branch of a segment is separated by a gap from the basal branch of the segment following; ♀-antenna simple; in both sexes the distal segments with several apical sensory cones (text-fig. 3). SC^1 of forewing with four subcostals, SC^1 nearly always from cell (text-figs. 72–79). Epiphysis of foretibia small or absent in ♀. Long hairs on tubercles of larva plumose. Cremaster of pupa with numerous involute spines.

♂♀. Frons much narrower anteriorly than the eye is high. Genal groove deep. In contradistinction to *Orthogonioptilum* angles of labrum not tuber-

culiform, not elevate. Palpus projecting beyond labrum, with distinct central constriction between segments I. and II., but the joint solid, the segments not movable against each other ; no separate third segment. Tongue very variable individually, from being several millimetres long to being reduced to two small tubercles, the two halves contiguous at base or separate.

Antenna of ♂ quadripectinate, in the larger species pectinate just beyond middle (12 or 13 segments pectinate, 10 or 11 non-pectinate) ; the distal branch of each segment apical, but as the proximal branches are not quite basal and, moreover, curve distad, the apical branch is not contiguous with the basal one

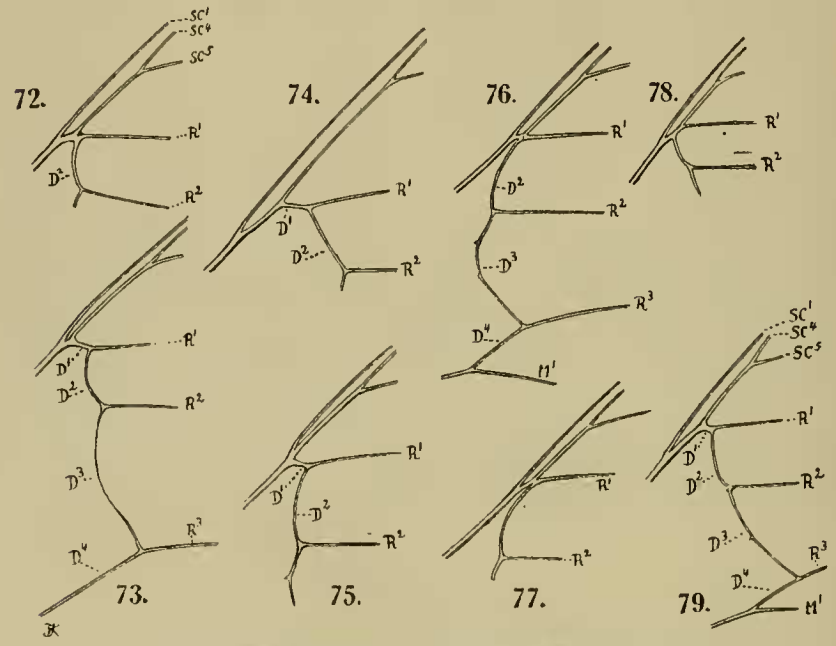


FIG. 72.—*Goodia oxytela* ♂ (Damba) ; neuration of forewing.
FIG. 73.—*Goodia nubilata* ♂ (Congo ?) ; neuration of forewing.
FIG. 74.—*Goodia oxytela* ♀ (Yakusu) ; neuration of forewing.
FIG. 75.—*Goodia hierax* ♀ (Nigeria) ; neuration of forewing.
FIG. 76.—*Goodia hierax* ♂ (Gold Coast) ; neuration of forewing.
FIG. 77.—*Goodia hierax* ♂ (Camerun) ; neuration of forewing.
FIG. 78.—*Goodia kuntzei* ♂ (Camerun) ; neuration of forewing.
FIG. 79.—*Goodia kuntzei* ♀ (Camerun) ; neuration of forewing.

following (or very rarely in one or the other segment) ; in this *Goodia* differs from all other *Ludiinae*. In ♀ non-pectinate, scaled above, flattened except distal segments ; there is usually a slight constriction in or beyond the centre of the segment, with indication of a subbasal and of an apical hump corresponding to the branches of the ♂-antenna, but in some forms the sides evenly rounded. In both sexes the distal segments at the apical margins with multiple sensory cones, somewhat as in true Saturnians. Segments in ♂ much longer than broad except distal ones, in ♀ with one or two short bristles on the subbasal hump (text-figs. 3, 80–83).

Foretibia with large epiphysis in ♂, a small one or none in ♀. Pulvillus

large ; paronychium long. Tarsal spines reduced to bristles, except the apical pair of the fourth foretarsal of ♀. One pair of spurs on mid- and hindtibiae. Sole of fifth segment densely scaled, except in foretarsus, where there is each side a non-scaled stripe studded with short sensory hair. Claw serrate.

Scaling soft, the upper scales deeply dentate ; fringe long. No organ of

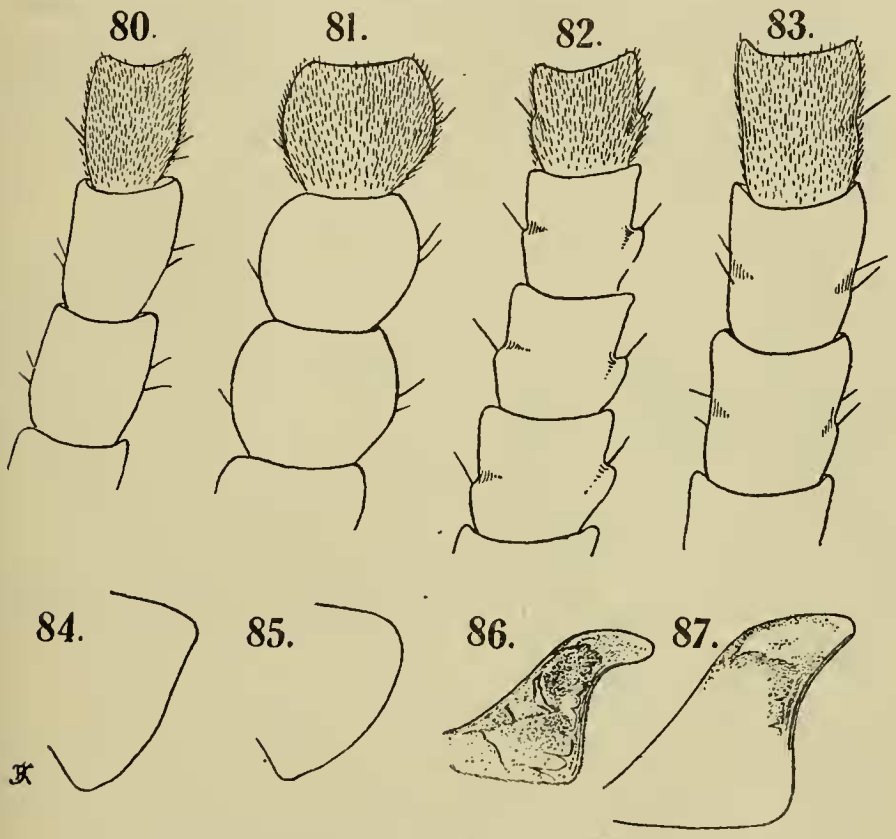


Fig. 80.—Segments 10 and previous of antenna of *Goodia thia* ♀ (Congo).
Fig. 81.—Segments 10 and previous of antenna of *Goodia hierax* ♀ (Nigeria).
Fig. 82.—Segments 10 and previous of antenna of *Goodia oxytela* ♀ (Damba).
Fig. 83.—Segments 10 and previous of antenna of *Goodia oxytela* ♀ (Yakusu).
Fig. 84.—*Goodia thia* ♀ ; hindwing (Luluabourg).
Fig. 85.—*Goodia hierax* ♀ ; hindwing (Nigeria).
Fig. 86.—*Goodia hierax* ♂ ; forewing, type.
Fig. 87.—*Goodia lunata* ♂ ; forewing, type.

stridulation. Forewing below and hindwing above with basal patch of shining modified scales.

Neuration : Forewing with four subcostals, SC^1 usually from cell, rarely a little beyond, SC^4 and SC^5 on a long stalk, SC^3 off SC^4 near apex as in *Holocera* ; discocellular D^1 short or absent, D^2 slightly incurved, D^3 very long, medianly more or less obsolescent (text-figs. 72–79).

Genitalia : ♂. Eighth tergite (text-figs. 88, 94, 99, 104, 106) produced, with or without median process ; eighth sternite medianly excurved or lobate-acu-

minate. Tenth tergite (X. t.) feebly chitinised, being a weak half-cylinder covering the anal cone, its angles more or less projecting. Tenth sternite (X. st.) with a long triangular median process, sulcate or flattened beneath. Penis-sheath granulate-dentate on outer side in the large species (text-figs. 102, 103), smooth in the small ones. Clasper different according to species.——♀. Genital selerite (text-figs. 96–98, 100, 105, 108) with a smooth transverse ridge behind the cavity, which is more or less arched, sometimes tuberculiform in centre, not dentate.

Early stages: Larva (of *G. sentosa*), according to Dr. A. Schultze, gregarious when young; with soft white hair; tubercles low, bearing black spines. Cocoon an open network of brown silk covered with bits of leaves, stalks, and soil (*G. kuntzei* in Mus. Brit.). Pupa (of *kuntzei*) without gloss, granulate; cremaster densely studded with spines which are involute at the ends; meso- and metanota without tubercle.

Among C. A. Dollman's drawings in the British Museum there is a picture of the larva of *G. kuntzei*: Yellowish green, head and abdominal legs black, anal claspers ferruginous with large black lateral spot; below spiracles a white stripe from segment V. to XII. edged with black-brown above from base of each segment to near spiracle. From supraspiracular tubercle obliquely forward and downward a paler yellowish-green line, a similarly coloured line above this tubercle. Spiracles black. Tubercles low; hair mostly black, forming two long dorsal tufts on II. and III. and one on XI. From the shed larval skin in the cocoon of *G. kuntzei* I can add the following detail: the long hairs of the larva plumose as in *Ludia*, the spines on the tubercles and the short hairs on the body smooth; tufts of about a dozen long brown plumose hairs on some tubercles, the brown hairs thicker than the white ones. Among this vestiture some curious gourd-hairs, flat in the dried state except the apex, which is filled with amber-coloured matter (poison ?), similar granules in the base of the gourd (text-fig. 109).

The species falls into two groups, which one might be inclined to treat as different genera. For the second group the generic term *Campimoptilum* is available. This name was proposed by Karsch (1896, August) for *G. kuntzei*, whereas the nearly allied *G. lunata* and *G. nubilata* were placed by him in *Orthogonioptilum*, of which he erroneously considered *Goodia* to be a synonym.

The name *Campimoptilum*, therefore, was originally due to an error in classification, but it may nevertheless be found useful, if and when the necessity arises of dividing *Goodia* up into several genera. *Lasioptila* Kirby (1896, November) is based on the same species, *kuntzei* = *ansorgei*. There are probably more species in existence than we know at present.

Key to the species:

I. Larger species: In ♂ 7 to 13 distal segments of the antenna non-pectinate; eighth abdominal tergite with long, narrow, somewhat spathulate process; penis-sheath with patch of small granules and teeth. Forewing much more falcate in ♂ than in ♀; in both sexes above with pale patch outside lower cell-angle.

A. No sharply defined terminal line on either wing.

1. Clasper of ♂ with median hook . . . . . *G. nubilata*
2. Clasper of ♂ with dentate apical hook . . . *G. sentosa*
3. Clasper of ♂ with long, smooth, apical hook . . *G. oxytela*

B. On both wings, above, a sharply defined chestnut-brown terminal line, separated from fringe by a thin pale line.

4. Forewing ♂ moderately falcate, apex of clasper pointed . *G. lunata*

5. Forewing ♂ strongly falcate, apex of clasper pointed, anal sternite spathulate . . . . . *G. hierax*

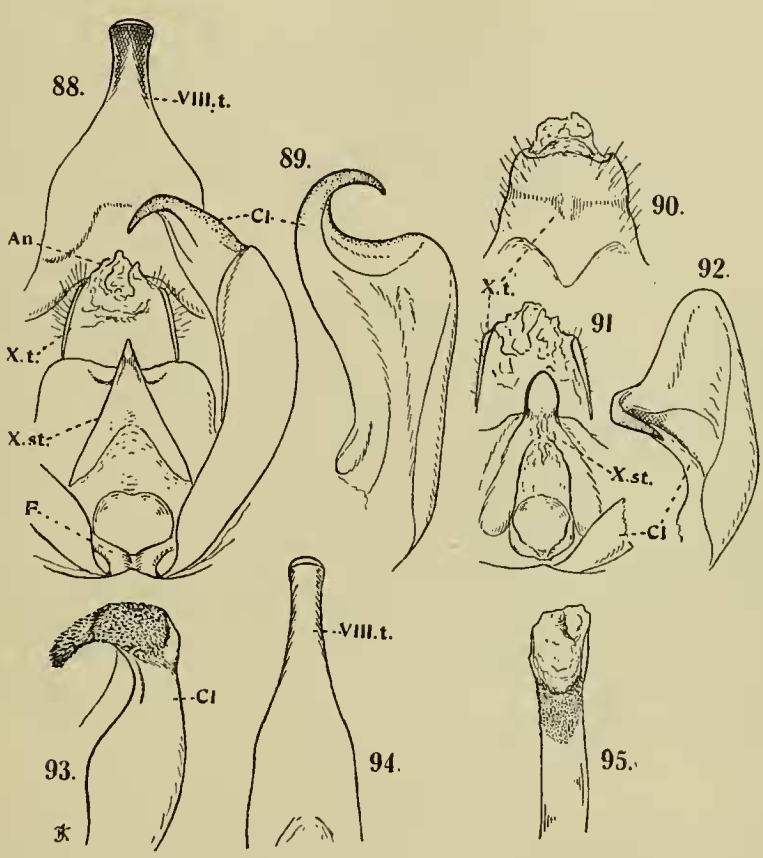


FIG. 88.—*Goodia oxytela* ♂; genitalia, ventral aspect.
FIG. 89.—*Goodia oxytela* ♂; clasper, inner side.
FIG. 90.—*Goodia nubilata* ♂; tenth tergite, dorsal aspect.
FIG. 91.—*Goodia nubilata* ♂; genitalia, ventral aspect.
FIG. 92.—*Goodia nubilata* ♂; clasper, inner side.
FIG. 93.—*Goodia sentosa* ♂; clasper, ventral aspect.
FIG. 94.—*Goodia nubilata* ♂; eighth tergite, ventral aspect.
FIG. 95.—*Goodia nubilata* ♂; penis-sheath, ventral aspect.

6. Forewing ♂ strongly falcate, apex of clasper obtuse, anal sternite sharply pointed . . . . . *G. thia*

II. Smaller species: In ♂ only 5 or 6 distal segments of the antenna non-pectinate; eighth abdominal tergite broadly rounded or with truncate median lobe; penis-sheath smooth. Forewing almost alike in shape in ♂ and ♀, without large pale patch outside lower cell-angle.

7. Forewing 27–35 mm. long; above with a narrow, long, evenly arched,

chocolate-brown, discocellular crescent bearing centrally a long, thin, vitreous line. Clasper with a bundle of apical spines. . . . . *G. kuntzei*

8. Forewing 18 to 28 mm. long, the discocellular mark more blackish brown, less regularly arched, shorter, with a shorter and less distinct vitreous line. Clasper without black spines at apex . . . . . *G. smithi*

There are in this genus two groups of particularly difficult species, the groups represented by *G. nubilata* and *G. lunata* respectively. The fair number of specimens we have seen of what seemed to be *G. nubilata* had nothing in the outward appearance suggestive of the existence of more than one species. The examination of the ♂-genitalia, however, gave a very different result. We find three quite distinct forms of claspers, from which fact we conclude that we are dealing with three distinct (*i.e.* independent) species.

To which of these outwardly similar insects do the names *G. nubilata* Holland (1893), *G. nodulifera* Karsch (1893), and *G. falcata* Auriv. (1893) apply? In cases like this, the descriptions and figures of externals as usually given in picture-book entomology are inadequate. I am most grateful to Dr. Holland and Professor Aurivillius for having examined the genitalia of the types of *nubilata* and *falcata* respectively and given me the information necessary for a correct application of these two names. The third name, *nodulifera*, was based on a single ♀. This specimen we regard as the ♀ of *nubilata*.

We have compared the external genital armature of 11 ♀♀. There is considerable individual variability in the structure of the vaginal sclerite, but we can nevertheless recognise among them three different types corresponding to the three types of ♂-genitalia.

The neuration is individually variable in all three species and does not present any specific differences. As a rule the upper cell-angle of the forewing, *i.e.* the angle formed by cross-vein D^1 with cross-vein D^2, is about 90°, but sometimes acute, sometimes (especially often in ♀♀) obtuse; occasionally D^1 is reduced to a point. In all specimens SC^1 of the forewing branches off from the cell (text-figs. 72–79) or from close to apex (text-fig. 75).

1. **Goodia nubilata** Holland (1893).

♂♀. *Goodia nubilata* Holland, *Ent. News*, iv. p. 179. tab. 11. fig. 3 ♂ (1893. early May) (Ogové River, ♀♀ partim); Packard, *Mon. Bombyc. Moths*, iii. p. 12 (1914) (descr. of ♂, ♀ mentioned).

♀. *Tagoropsis nodulifera* Karsch, *Berl. Ent. Zeits.* xxxvii. p. 500. no. 16 (1893) (middle of May) (Buea, Camerun).

♂. *Tagoropsis ? falcata* Aurivillius, *Ent. Tidskr.* xiv. p. 202. no. 7 (1893, end of May) (Camerun).

Goodia ("*Tagoropsis*") *nodulifera*, Strand, *Arch. Naturg.* lxxviii. A. 6. p. 145. no. 10 (1912) (Spanish Guinea).

Identified from sketch of genitalia kindly supplied by Dr. J. W. Holland. Professor Aurivillius has examined the tail-end of *falcata*-type; it agrees with that of *nubilata*.

♂♀. Ochreous, much shaded with ochraceous and russet. Occiput and pronotum greyish white. Costal area of forewing shaded with grey from base to postmedian bent; a postdiscal crenulate line brown, accentuated on the veins by blackish brown arrow-heads; a pale buff-yellow patch outside lower cell-angle traversed by vein R^2, conspicuous; an apical patch of the same colour, irrorated with black. Both wings (if in good condition) with small tufts of pale

scales, which are broad at apex and deeply dentate, but otherwise very slender, such scaling especially abundant in abdominal area of hindwing, above and below.——*Underside* with numerous brownish black speckles ; forewing outside cell, hindwing in cell and in apical region pale buff, more or less conspicuously shaded with pink in fresh specimens. Antenna in ♂ with 12 or 13 segments quadripectinate, 8 or 9 non-pectinate. Forewing strongly falcate in ♂. Wings much broader in ♀, apex of forewing acuminate, projecting beyond termen.

Genitalia : ♂. Eighth tergite produced into a long median process which is not unlike a hock-bottle when viewed from beneath ; the process is gently curved downwards, convex above and flat beneath, apically rounded and usually distinctly dilated (text-fig. 90). This process takes the place of the anal tergite, which is reduced to a weak half-cylinder forming the dorsal covering of the anus. Tenth sternite an oblong, transverse, slightly incurved sclerite, from the ventral surface of which projects a triangular or spatulate process (text-fig. 91). Clasper irregularly elongate-ovate ; ventral and apical margins simple, but from dorsa margin at a considerable distance from apex a long, curved, sharply pointed process projects towards the anus and recurves ventrad to some extent (text-figs. 91, 92). Penis-sheath with patch of pointed granules, the longitudinal diameter of the patch rather shorter than the transverse diameter of the penis-sheath ; penis-funnel not independent of anal sternite (X. st.), being fused with it.—— ♀. Aperture of genital sclerite (text-fig. 96, Camerun) much smaller (in the only specimen examined) than in the next two species, ovate, longer than broad ; behind it a smaller cavity bounded on posterior side by a smooth, semicircular ridge, which laterally is connected with an oblique longitudinal ridge extending forward and joining the anterior margin of the vaginal cavity. The proximal margin of the sclerite is mediânly raised as a transverse carina. At each side of the post-vaginal semicircle and separated from it by a long and irregular ridge a large hump scaled like the sides of the eighth segment. Area posterior to the semicircle membranous.

Hab. Camerun and Ogové River, probably more widely distributed.

In Mus. Tring from Victoria, Camerun (Preuss), 1 ♂ ; Upper Congo ?, 1 ♂.

In coll. Joicey from Bitje, Ja River, Camerun (G. W. Bates), June and October, 4 ♂♂, 1 ♀.

In coll. Holland a series of both sexes from Camerun and Ogové River.

In Mus. Berlin from Camerun.

2. **Goodia sentosa** spec. nov.

♀. *Goodia nubillata* (!), Sonthonnax (nec Holland, 1893, error identif.), *Essai Classif. Lép.* iv. p. 45. no. 3. tab. 26. fig. 4 (1904) (Ogové ; Mus. Brit.).

Goodia nodulifera var. *nubilata*, Strand, *Arch. Naturg.* lxxviii. A. 6. p. 145. no. 11 (1912) (Spanish Guinea ; larva mentioned).

Goodia nodulifera, Schultze (nec Karsch, 1893), *ibid.* lxxx. A. 1. p. 161. no. 23 (1914) (Camerun, early stages).

♂♀. Occurs together with the preceding species. Colouring more diffuse, markings less prominent, especially the postdiscal scalloped line, together with its pale border not quite so well expressed as in *G. nubilata* ; on underside the pinkish tint usually less conspicuous and more restricted, and the black disco-cellular dot on the hindwing a little larger.

Genitalia: ♂. Process of eighth tergite broader proximally than in *G. nubilata*, dorsally carinate; eighth sternite medianly more rounded, less acuminate. Clasper very different, bearing a long, somewhat twisted process which projects mesad from the ventral margin at the apex and is densely studded with small teeth (text-fig. 93). Penis-sheath thicker than in *G. nubilata*, the patch of teeth larger, the teeth coarser. Penis-funnel anteriorly higher than in *G. nubilata*.——♀. Aperture (text-fig. 97, Camerun) larger than in *G. nubilata*; its margin raised all round, the small postvaginal groove being separated by this elevate margin from the main cavity; postvaginal arc as in *G. nubilata*, but shorter; sclerite less impressed laterally to cavity.

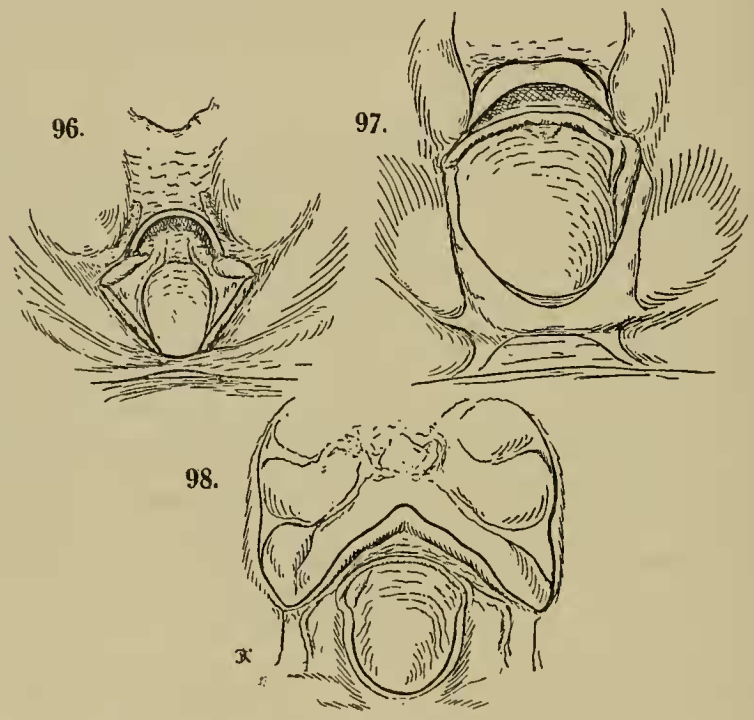


FIG. 96.—*Goodia nubilata* ♀; genital sclerite, ventral aspect.
FIG. 97.—*Goodia sentosa* ♀; genital sclerite, ventral aspect.
FIG. 98.—*Goodia oxytela* ♀; genital sclerite, ventral aspect.

Early stages: According to Schultze the larva white, with a greenish tint shining through; stigmata bright ochreous; tubercles dull green, with some brown-black spines; head and thoracic legs deep ochreous, abdominal legs and anal claspers dull ochreous; some specimens with large black patches on underside. The whole body covered with long white hair, partly in tufts. Gregarious when young, close together on the underside of a leaf. In May and again in August, probably several broods during the year.——Cocoon rather small, loose, brown, covered with bits of leaves. Imago appears in 4 to 5 weeks in daytime, flies at night.

Food-plant: *Amomum* (*Zingiberaceae*).

Strand says: The larva (♂), according to Tessmann, densely covered with snow-white hair, on segments II. and III. laterally longer tufts, head brown-red, legs dark.

Hab. Camerun; Spanish Guinea; Ogové River.

In Mus. Tring from Spanish Guinea, 1 ♂ (*type*); Alén, Benito, 1 ♀; and Nkolentangan, Spanish Guinea, 1 ♀; all collected by G. Tessmann and received from the Berlin Museum.

In the British Museum a ♀ from Ogové River, "cotype" received from Dr. Holland; I consider the specimen to belong here.

In coll. Joicey from Bitje, Ja River, Camerun (G. W. Bates), 1 ♂, 3 ♀♀; Mungo-ma-Lolah (near Victoria), Camerun (ex coll. Druce), 2 ♂♂, 1 ♀.

In Mus. Berlin from Spanish Guinea (Tessmann) and N.W. Camerun (Arnold Schultze).

3. **Goodia oxytela** spec. nov.

♂♀. In colour and pattern like *G. nubilata*, differing in the genitalia. For neuration and antenna, cf. text-figs. 74, 82, 83.——♂. Process of eighth tergite (text-fig. 88) proximally even broader than in *G. sentosa*, this broad portion shorter and more abrupt than in that species, the apical portion narrower, not carinate above, less widened at apex; eighth sternite acuminate in centre. Process of tenth sternite sharply pointed, narrower than in *G. sentosa*. Clasper armed with a long, pointed hook which projects from the dorsal portion of the apical margin and is curved inward and basad; the ventral portion of the apex is produced as a broad, short, rounded lobe (text-fig. 89). On the inner surface of the clasper a deep channel runs from the base on to the hook parallel with the raised dorsal margin of the clasper. Penis-funnel ventrally about as short as in *G. nubilata*. Penis-sheath as stout as in *G. sentosa*, and the patch of teeth similar, extending on to the dorsal surface.——♀. Aperture of genital sclerite (text-fig. 98, Damba) large, the basal area of the sclerite smooth; the margin of the cavity elevate also posteriorly, bounding the postvaginal groove; the posterior wall of this groove is formed by a more or less triangular ridge or lobe, which is much higher than in both the previous species, and, instead of being continuous with the margin of the cavity, curves backwards at the sides and runs anad as a sharp ridge. From this longitudinal ridge two transverse ridges run on to the postvaginal median area (eighth sternite), which is much larger than in the two preceding species.

Hab. Uganda; Upper Congo.

In Mus. Tring 1 ♂ and 1 ♀ and 2 pupae from Damba Island and Bugalla Island, Victoria Nyanza, bred August and December (Dr. G. D. H. Carpenter), received from Professor E. B. Poulton.

In Mus. Oxon a series from the same places.

A somewhat larger and darker-coloured ♀ from Yakusu, Upper Congo (K. Smith), in Mus. Tring also belongs here. In this ♀ the lobe behind the genital orifice is longer and its margin thicker than in Carpenter's examples. The antenna has the slight projections barely indicated (text-fig. 83).

The second group of species, exemplified by *G. lunata*, presents us with greater difficulties even than the preceding group, especially because the number

of specimens we have seen is very small, and because there was not a single example among them which agreed in the contour of the forewing either with *G. lunata* or with *fulvescens*. In these circumstances our endeavour to clear up the systematics of the group should be regarded as tentative. We will enumerate the facts which, for the time being, must guide us in forming an opinion :

(1) The specimens we have seen, as well as those of which Dr. Holland has very kindly sent us photographs, are practically identical in pattern, but there are differences in size, wing-contour, genitalia, and ♀-antennae.

(2) In *G. lunata* Holland (1893), of which we have a beautiful photograph, the forewing is moderately falcate (text-fig. 87).

(3) In *G. fulvescens* Sonth. (1898), likewise based on a ♂, the forewing resembles that of *G. lunata*, but the apex is much more broadly rounded off. This difference may be due to Sonthonnax's figure being incorrect, and may be dismissed as non-existing.

(4) The ♂♂ before me and photographs of 2 ♂♂ in Dr. Holland's collection have the forewing strongly falcate (cf. text-fig. 86).

(5) The clasper of *G. lunata* type is evidently the same as in the falcate ♂♂, judging from sketches kindly given me by Dr. Holland ; the other portions of the genitalia of *G. lunata* type have not been examined.

(6) Among the falcate ♂♂ before us is one in which the clasper differs slightly, the other genital organs strongly. It is therefore possible that in the case of *G. lunata* type those non-inspected portions also show differences from the more strongly falcate ♂♂.

(7) We have seen 4 ♀♀, two of them have been closely investigated. One of these two differs in the contour of the hindwing, the shape of the antennal segments, and very slightly in the genital plate.

This is all the evidence before us. It is quite clear that the strongly falcate ♂♂ belong to two species. One of them may be the same as *G. lunata*. Which one ? On the other hand, the subfalcate types of *G. lunata* and *fulvescens* may represent a third species. As the contour of the forewing in these types is undoubtedly different, and as the genitalia have not yet been compared minutely, it is advisable to treat *lunata* as distinct from the falcate species. As regards the two forms of ♀♀, we can only express the hope that we have assigned to them their right positions.

4. **Goodia lunata** Holland (1893).

♂. *Goodia lunata* Holland, *Ent. News*, iv. p. 179. no. 19. tab. 9. fig. 2 ♂ (1893) (Ogové River).

(?) ♂. *Goodia fulvescens* Sonthonnax, *Ann. Labor. Ét. Soie* ix. p. 157. tab. 3. fig. 3 (1899) (Congo in coll. Oberthür) ; id., *Echange*, xvi. p. 30 (1900) ; id., *Essai Classif. Lép.* iv. p. 16. no. 4. tab. 26. fig. 5, ♂ (1904) (Congo).

♂. *Goodia lunata*, Strand, *Iris*, xxiv. p. 188 (1910) (= *fulvescens* ?) ; id., *Arch. Naturg.* lxxviii. A. 6. p. 145. no. 12 (1912) (Spanish Guinea).

(?) ♀. *Goodia lunata*, ab. *obscuripennis* Strand, *Arch. Naturg.* lxxviii. A. 6. p. 145. sub no. 12 (1912) (Alén, Spanish Guinea).

♂. Forewing moderately falcate (text-fig. 87), nearly as in *G. nubilata* ; a straight line connecting extreme point of apex with end of vein R^2 and prolonged backwards crosses hindwing about centre, in the two following species near base ; distance of lower cell-angle from termen, 11 mm. ; transparent discocellular line short, not extending to upper cell-angle, and also obscured behind ; the dull

tawny ochraceous area outside the discocellular bar does not project so far towards termen between SC^5 and R^1 as in the more falcate species. Clasper with short apical hook (the other parts of the genital armature still require to be studied).

Ochraceous, shaded with clay-colour in parts; pronotum grey or purplish grey; anterior edge of mesonotum and underside of body a deep chestnut. Forewing, above, more or less shaded with pale clay-colour from base to discocellular bar and on apical lobe; outside lower cell-angle a brighter ochraceous patch, above this patch a dull tawny-hazel area and below the patch a blackish or purplish brown cloud; antemedian line separated into two parts, which are parallel with one another and not connected, anterior portion in middle of cell, posterior portion much longer, beginning not quite halfway to base at vein M and running very obliquely to near middle of hindmargin; a very thin submarginal line parallel with termen to apical lobe and here curved costad; this line straight between the veins from R^1 to SM^2, but forming on the veins very sharp arrowheads or angles pointing basad; these lines more or less deep chestnut like the discocellular lunule; close to fringe, but separated from it as well as from submarginal line, a thick uninterrupted line of the same tawny-brown colour as the fringe.——Submarginal and admarginal lines of hindwing as on forewing.

On *underside* the cell of forewing greyish, bearing a blackish patch in middle, a small spot of a similar dark colour near bent of costa.

Hab. Ogové River; Congo.

One ♂ in coll. Holland and another from the Congo in coll. Oberthür. I have placed here the ♀ named ab. *obscuripennis* by Strand, but am as doubtful about its position as I am in the case of the other ♀♀ mentioned under the next two species. In this specimen the middle segments of the antenna are very little longer than broad and show very slight indications of teeth. The disc is suffused with black in both wings.

5. **Goodia hierax** spec. nov.

♂. In colour and pattern like the preceding, but forewing much more strongly falcate (text-fig. 86), dull tawny-hazel postmedian area projecting between SC^5 and R^1 to near margin.——Antenna with 12 segments quadripectinate and 10 or 11 simple, the former segments much longer than the latter; apex of penultimate segments ventrally much produced.

Genitalia: Eighth tergite gradually narrowed from the broad base to beyond middle, thence narrow to apex, this narrow process rather less than 1 millimetre long, slightly curved downward, convex above; apex rounded, beneath flat. Eighth sternite with a broad obtuse median lobe which does not project much (text-fig. 99). Tenth sternite very distinctive, the process widened apically, the apex broadly rounded. Clasper acuminate, the tip turned mesad, forming a short hook. Penis-sheath not quite so wide as the apex of the eighth tergite; the patch of teeth extending all round, being distally about parallel with the apical edge of the sheath and extending on ventral side much more cephalad than dorsally (text-fig. 102).

♀. Forewing much less falcate than in ♂, much broader, apex more pointed; markings as in ♂, but pale clayish apical area more sharply defined between

SC^5 and R^1; on *underside* no black spot in cell and the subapical black dot larger. ——Hindwing (text-fig. 85) somewhat longer costally than abdominally; apex rounded; termen convex; anal angle faintly produced. Antenna moniliform, the segments rounded at the sides (text-fig. 81).

Genitalia: Aperture ovate, placed obliquely, the cavity extending into the body towards the left side; this asymmetry noticeable also in *G. nubilata* and allied species (text-fig. 100). Rim of aperture highest behind. From in front of the aperture a fold runs obliquely laterad and joins a postvaginal transverse smooth ridge (or plate), which is slightly narrowed in centre.

For neuration of both sexes, cf. text-figs. 75–77.

Hab. Gold Coast; Cameroons; French Congo.

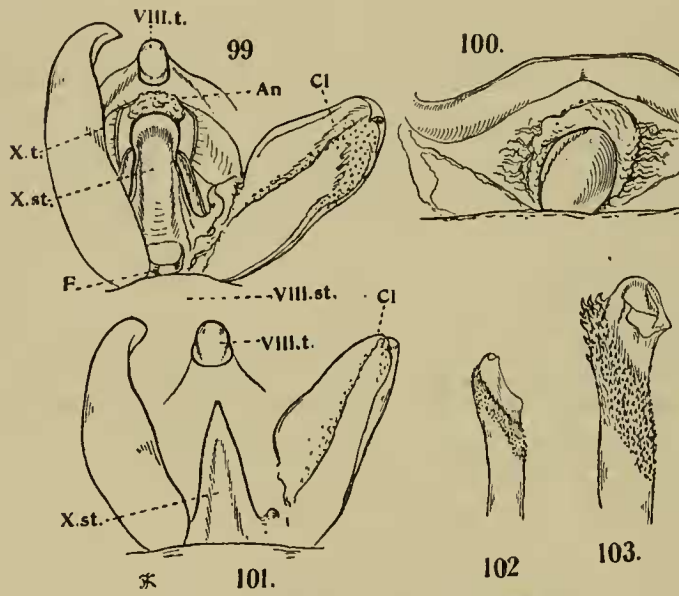


FIG. 99.—*Goodia hierax* ♂; genitalia, ventral aspect.
FIG. 100.—*Goodia hierax* ♀; genital sclerite.
FIG. 101.—*Goodia thia* ♂; genitalia, ventral aspect.
FIG. 102.—*Goodia hierax* ♂; penis-sheath, lateral aspect.
FIG. 103.—*Goodia thia* ♂; penis-sheath, lateral aspect.

In Mus. Tring 1 ♂ from Wassaw district, 45 miles inland from Sekondi, Gold Coast, *type*; Nigeria, 1 ♀.

In Mus. Brit. 1 ♂ from Port Victoria, Camerun (Captain Fitzroy).

In Mus. Berlin from Uelleburg, Spanish Guinea, and Kuilu, French Congo, 2 ♂♂ and 1 ♀.

6. **Goodia thia** spec. nov.

♂. Like the preceding species, *G. hierax*, but differing in the genitalia. Process of eighth tergite stouter, the apex wider and dorsally more convex. Eighth sternite slightly thickened medianly, but not distinctly produced. Tenth sternite elongate-triangular, sharply pointed (text-fig. 101). Clasper less acuminate than

in *G. hierax*, without apical hook. Penis-sheath broader, the patch of teeth larger, the teeth longer, particularly dorsally (text-fig. 103).

♀. The specimen I place here possibly belongs to another species. It is larger than the ♀ mentioned above under *G. hierax* ; the segments of the antenna are longer and less rounded (text-fig. 80) ; the termen of the hindw ng is incurved below apex, the apical angle distinctly projecting (text-fig. 84). Vaginal sclerite similar, but the basal fold higher, the rim of the aperture thicker laterally, and the postvaginal transverse ridge higher.

Hab. Camerun ; Congo.

In Mus. J. J. Joicey 1 ♂ (*type*) from Bitje, Ja River, Camerun (G. W. Bates).

In Mus. Tring 1 ♀ from Luluaburg, Kassai, Congo (R. Landbeck).

7. **Goodia kuntzei** Dewitz (1881).

Saturnia kuntzei Dewitz, *Nova Acta Leop. Carol. Ak. Naturf.* xlii. 2. p. 70. tab. 2. fig. 14 ♂ (1881) (Guinea).

Saturnia (?) *kunzei* (!), Kirby, *Cat. Lep. Het.* p. 773. no. 18 (1891) (Guinea).

Orthogonioptilum kunzei (!), Rothschild, *Nov. Zool.* ii. p. 49 (1895).

Campimoptilum kunzei (!), Karsch, *Ent. Nachr.* xxii. p. 248 (1896).

♀. *Lasioptila ansorgei* Kirby, *Ann. Mag. N.H.* (6). xviii. p. 386. no. 43. tab. 19. fig. 8 ♀ (1896) (Uganda).

♀. *Lasioptila selene* Kirby, *l.c.* sub no. 44 (1896) (*selene* probably was the name Kirby originally intended to give to this species).

♂♀. *Goodia hollandi* Butler, *Proc. Zool. Soc.* p. 430. no. 188. tab. 33. fig. 1 ♂ (1898) (Voi, ♂ ; Yaru, ♀)

Goodia ansorgei, Butler, *l.c.* sub no. 188 (1898).

Goodia kuntzei, Distant, *Ins. Transvaal.*, p. 64. no. 23. tab. 5. fig. 6 ♂ (1903) (Transvaal).

♀. *Campimoptilum ochraceum* Aurivillius, *Tidskr. Ent.* xxii. p. 123. no. 98 (1901) (German E. Africa).

Goodia hollandi, Sonthonnax, *Essai Classif. Lép.* iv. p. 44. no. 1. tab. 26. fig. 3 ♂ (1904) (♂♀, Tanganyika).

Goodia ansorgei, id., *l.c.* p. 45. no. 2 (1904) (= *kuntzei*).

Lasioptila ansorgei, Straud, *Iris*, xxiv. p. 189 (1910) (doubts identity with *kuntzei*).

In colour and pattern similar to *G. lunata*, but differs considerably in the outline of the wings, size, scaling, antennae, etc. The species being fairly common in Central and East Africa, we have seen a good series of specimens, ranging in general coloration from hazel to clayish buff, the ♀♀ as a rule being paler than the ♂♂. This variability in colour accounts for the string of synonyms.

The scaling is very soft, like fur, the upper scales being deeply divided up into long hair-like teeth nearly over the entire upper and under surfaces inclusive of fringe ; the long-stalked pale scales which project above the general scaling are less deeply dentate.

♂♀. Apex of forewing usually pointed and distinctly produced, but sometimes rectangular and not produced ; the proximal area from base to beyond upper cell-angle and to one-third of hindmargin paler than rest of wing, sometimes contrasting rather strongly with it ; this area bounded by a very diffuse, shadowy, darker median band, which is usually blackish brown at hindmargin and extends along the margin to the crenate postdiscal line ; discocellular arc thin, regularly curved, bearing a very thin transparent line, which usually extends from near one end of the arc to the other ; below apex a blackish brown, more or less triangular, cloud, rarely absent.——On hindwing a postdiscal line as on forewing, but much less crenate, often without dentition, incurved before abdominal margin. In both wings base of fringe ochreous, forming a pale line separating

a dark hazel terminal line from the similarly coloured dark line occupying the apex of the fringe.

Neuration: Lower cell-angle of forewing less than 90°; R^1 variable in position, sometimes off stalk of subcostals; cf. text-figs. 78, 79, which illustrate the variation in the position of SC^1 and R^1.

Antenna in ♂ quadripectinate to near apex, the branches slender and, owing to their thinness, irregularly curved (in dry cabinet-specimens), apical branches and the following proximal branches closer together at their bases than in the preceding forms, but soon diverging, their apices usually crossing each other; 15 to 17 segments quadripectinate and 5 or 6 non-pectinate, the latter (except

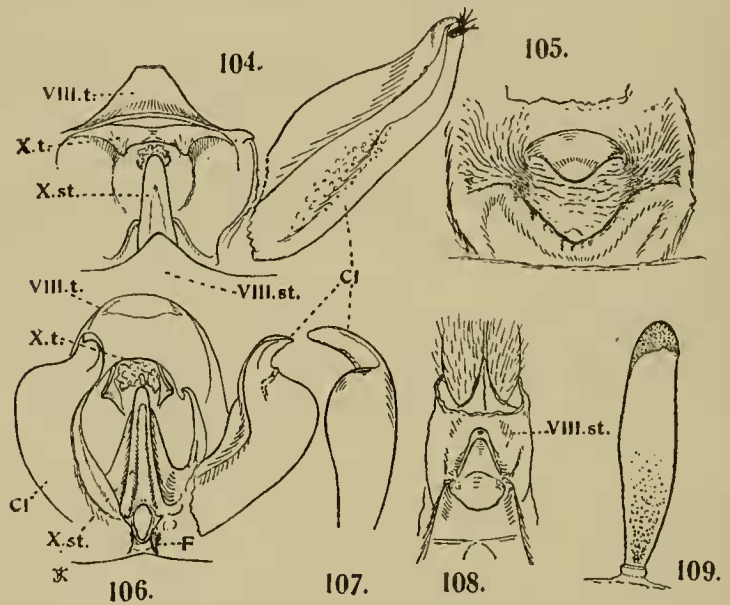


FIG. 104.—*Goodia kuntzei* ♂; genitalia, ventral aspect.
FIG. 105.—*Goodia kuntzei* ♀; genital sclerite.
FIG. 106.—*Goodia smithi* ♂; genitalia, ventral aspect.
FIG. 107.—*Goodia smithi* ♂; clasper, ventral aspect.
FIG. 108.—*Goodia smithi* ♀; genital sclerite.
FIG. 109.—*Goodia kuntzei* ♀; gourd hair of larva.

last one) with their multiple sense-cones ventrally strongly produced distad.—— In ♀ simple, 19 to 23 segments, proximal two-thirds of them somewhat flattened ventrally and their apical margins oblique; on each side a small hump bearing a few short bristles; length of segments not constant, in some specimens the central ones longer than broad, in others broader than long, with intermediates.

Genitalia: ♂. Eighth tergite (text-fig. 104) gradually narrowed to form either a stumpy median lobe which is truncate or rotundate at apex, or (rarely) a longer triangular process of which the tip is rounded off. Eighth sternite medianly widened, angulate, the apex of the angle distinct though obtuse. Tenth tergite with the lateral angles projecting, its upperside concave; tenth sternite produced into a long median process which varies individually, being

sometimes almost spathulate, sometimes more elongate-triangular with the tip rounded off. Clasper very distinctive, elongate, somewhat twisted, with an apical bunch of about 8 black spines (text-fig. 104); a deep channel runs from base of clasper to apex. Penis-sheath without armature, the membranous apical area several times as long as the sheath is wide, being very much longer than in *G. lunata*; penis-funnel also different from that of the previous species, being anteriorly about as long as it is broad and vanishing posteriorly.——♀. The cavity of the genital sclerite (text-fig. 105) is anteriorly bounded by a curved ridge which runs obliquely laterad to join the lateral longitudinal fold; as the sclerite is submembranous in and laterally to the cavity, it is more contracted in some (dry) specimens than in others, the cavity being accordingly sometimes longer than in our figure and the sides of the basal ridge more longitudinal. Behind the cavity a large central tubercle, convex above, concave on the side towards the cavity, variable in size, and appearing almost semilunate when viewed from front.

Early stages: cf. p. 294.

Hab. From Angola and Natal north-eastward to British East Africa.

In Mus. Tring a series from: Shilouvane, Transvaal (Dr. Junod); North-east Rhodesia (Dollman); Selukwe, Rhodesia; Nyasaland; Kalambo River, south end of Lake Tanganyika; Mamboia (Dr. Baxter); Masasi, ex-German East Africa.

In Mus. Brit. 1 ♂ from Voi River (type of *hollandi*) and a series of ♀♀ from Stanger, Natal (J. Delvin), Transvaal, Mashonaland, Rhodesia, and Katanga.

Also in Mus. J. J. Joicey and Mus. Berlin.

8. **Goodia smithi** Holland (1897).

♂. *Saturnia* (?) *smithi* Holland, in Donaldson Smith, *Through Unkn. Afric. Countries*, p. 413. tab. fig. 13 ♂ (1897) (loc. ?; congeneric with "*S.* (?) *kunzi*"); Strand, *Iris*, xxiv. p. 188 (1910) (belongs to *Campimoptilum*).

♀. *Goodia hollandi* Butler, *Proc. Zool. Soc. Lond.* p. 430. no. 188 (1898) (partim; ♀, Yaru).

♂♀. *Goodia oriens* Hampson, *Trans. Zool. Soc. Lond.* xix. p. 129. tab. 4. fig. 42 ♂ (1909) (Ruwenzori; ♀ *hollandi* Butl. 1898 this species).

♂. *Goodia decolor* Le Cerf, *Bull. Mus. Hist. Nat.* xvii. p. 308 (1911) (Kiu, Brit. E. Africa).

♀. *Goodia uniformis* Joannis, *Bull. Soc. Ent. Ital.* xliv. p. 139 (1912) (Eritrea).

♂♀. *Goodia oriens heptapora* Fawcett, *Proc. Zool. Soc. Lond.* p. 104. no. 81. tab. 1. fig. 13 ♂ (1915) (Kedai, Brit. E. Africa; lines of forewing too strong in fig.).

The smallest species of the genus, and, like *G. kuntzei*, liable to individual variation in size and colour. Wings more thinly scaled in ♀ than in ♂, with the markings less prominent, and the general colouring duller, a darker or lighter drab-brown, the veins standing out more distinctly than in the ♂.

♂. Varying from drab-brown to pale hazel with a tint of rufous, sometimes the forewing nearly black; hindwing paler than forewing, especially at base; basal half and apex of forewing usually shaded with grey. Markings as in *G. kuntzei*, but the discocellular lunule shorter and less regularly arched, with the vitreous line absent or vestigial; postdiscal crenulate line accentuated on the veins as in *G. kuntzei*, sometimes the line obsolete between the veins. Scaling similar to that of *G. kuntzei*.

Antenna similar to that of *G. kuntzei*-♂, quadripectinate to near apex, 16 to 18 segments pectinate and long, 4 to 6 non-pectinate and short, the branches

slender, crossing one another, apical branch and the following proximal branch not quite contiguous at their bases.

♀. The scales of wings reduced in width, most of the upper scales of the underside deeply divided into two hair-like prongs. Antenna simple, with 21 to 24 segments; middle segments somewhat flattened, longer than broad, more or less constricted centrally, apical margin oblique, vestigial lateral humps with a few short bristles.

Neuration: SC^1 of forewing as a rule from cell near apex, frequently from upper angle, rarely from beyond; in one ♂ from angle in right wing and from beyond in left wing, being coalescent with stalk of subcostal fork (the line of division partially indicated); lower cell-angle usually acute, rarely 90°.

Genitalia: ♂. Eighth tergite (text-fig. 106, VIII. t.) broadly produced, almost concealing the claspers in a view from above, strongly rounded, often the margin irregular, sometimes bituberculate medianly, not narrowed into a median process. Eighth sternite with a rudimentary median lobe, which is often missing. Clasper widest beyond middle, where the ventral margin is strongly rounded-excurved; dorsal margin incurved (text-fig. 106, the claspers, Cl, bent sideways, so as to show their inner surfaces); apex narrowed to form a somewhat variable hook, which in a view from the ventral side (text-fig. 107) is directed mesad. Tenth tergite (X. t) deeply sinuate, feebly chitinised, the angles projecting. Tenth sternite (X. st.) with a long median process, somewhat variable in contour, with a central ventral channel. Penis-sheath very slender, without armature; penis-funnel (F) anteriorly elevate, the rim fading away posteriorly.——♀. On the frontal side of the cavity the genital sclerite, in the specimen from which our figure is taken (Kibwezi), smooth, transversely convex, somewhat tubuliform; in other examples this area is more or less concave (collapsed ?) and the anterior margin of the central cavity is raised as a transverse ridge. Behind the cavity a median tubercle, hollow on frontal side and considerably raised above the level of the membranous postvaginal sternite (VIII. st.), variable in width.

Early stages not known.

Hab. Eastern half of the continental Aethiopian Region: from Eritrea, Harar, and the White Nile south- and westward to the Ruwenzori and British East Africa, probably also occurring further south.

Both sexes come to the light.

In Mus. Tring from: Harar (G. Kristensen), 1 ♂; White Nile, lat. 12° 11′ (Captain Yardley), 6 ♂♂; S.E. Ruwenzori, 3,500 ft., June 1906 (Legge and Wollaston), 4 ♂♂; Entebbe, Uganda (F. J. Jackson), 2 ♂♂; Kedai, November 1914, and Kibwezi, British East Africa, January, April, November, December (W. Feather), a series of both sexes.

In Mus. Brit. from: S.E. Ruwenzori as above, 4 ♂♂, 1 ♀; Yaru and Kedai, British East Africa, 1 ♂ (type of *heptapora*), 1 ♀; British Somaliland, 1 ♂; Mongalla Province, S. Soudan.

In Mus. Oxon a series from the Nuba Mts., Sudan (10° 39′ lat. N.) (R. S. Wilson).

6. Genus: **Orthogonioptilum** Karsch (1893).

Orthogonioptilum Karsch, *Berl. Ent. Zeits.* xxxvii. p. 501 (1893, May) (type not specified.—We select *adiegetum* as genotype); Holland, *Ann. Mag. N.H.* (6). xii. p. 251 (1893) (= *Goodia*, errore); Karsch, *Ent. Nachr.* xxii. p. 247 (1896) (= *Goodia*, errore; neuration of *O. prox*); Auriv., *Arkiv Zool.* ii. 4. p. 21 (1904) (different from *Goodia*, if Karsch's descr. of neuration correct), Strand, *Iris*, xxiv. p. 187 (1910) (distinctions from *Goodia*, enumerat. of species; his remark, p. 187, on position of *Orthogonioptilum* erroneous, Strand having misunderstood Aurivillius).

Guillemeia Sonthonnax, *Ann. Lab. Et. Soie Lyon*, ix. p. 158 (1899) (type not specified.—We select *tristis* as type); id., *Échange*, xvi. p. 30 (1900); id., *Essai Classif. Lép.* iv. p. 47 (1904); Strand, *Iris*, xxiv. p. 188 (1910).

Goodia, Weymer (nec Holland 1893, err. in classific.), *Iris*, xxii. p. 14 (1909).

Ludia, id., *l.c.*

Carnegia, Strand (nec Holland 1896, err. in classific.), *Iris*, xxiv. p. 185 (1910).

Near *Goodia*, but in the ♂-antenna the apical branches of a segment contiguous with the proximal branches of the segment following, not separated by a gap at their bases as in *Goodia*, the branches regular in arrangement; in ♀ the antenna quadri- or bipectinate, not simple as in *Goodia*; first subcostal of forewing always beyond cell; epiphysis of foretibia large in both sexes, but smaller in ♀ than in ♂; labrum and angle of clipeus raised on each side as a prominent tubercle; anal angle of hindwing of ♀ projecting inward; etc.

The sexes are much more different than in any other genus of *Ludiinae*, which renders it sometimes exceedingly difficult to ascertain which ♂♂ and ♀♀ belong together. Strand, who described a new species of "*Carnegia*" from a ♀ of *Orthogonioptilum*, and Weymer, who described one ♀ as a new *Holocera*, another as a new *Ludia*, and a ♂ of the former as a new *Goodia*, were not aware of this troublesome fact. Unfortunately, the difficulties one encounters in this genus do not end there. In several instances the ♂♂ are almost identical in markings, while they are very distinct in the genital armature, the descriptions and figures of the ordinary type being of little help for identification unless accompanied by a sketch of the sexual armature. Moreover, the vitreous marks of the ♀, on which Strand and Weymer lay great stress, are proved by the series of ♀♀ of *O. incana* before me to be variable in that species, and therefore may possibly also be unreliable in the other species, as I think they are. Furthermore, we are greatly puzzled by the absence in some specimens of the tuft of modified scales usually present on the underside of the forewing near tornus in the ♀, and homologous to the stridulation-scales of *Ludia* and *Holocera*. Is the presence of this feminine adornment of plumes (or organ of attraction) always of specific value, or is it sometimes merely an individual distinction? The genital armature varies in detail to a considerable extent in *O. incana*, the species of which alone we have a series of ♀♀ before us, only the general arrangement of the armature being the same in the various specimens.

In the case of other species no more than one or two examples of the ♀ are available, each with its own peculiarities, which renders it difficult or even impossible at our present state of knowledge to decide which features of a specimen are characteristic of the species.

Dr. Holland has been so kind as to assist us with sketches of the genitalia of the types of *O. vestigiata* ♂ and *O. kahli* ♂, and I have examined at the Berlin Museum the types of *O. adiegetum* ♂, *O. prox* ♂, *O. monochromum* ♂, and *O.*

geniculipennis ♀, and in coll. Richelmann the types of *O. servatia* ♀, *O. pancratia* ♀, and *O. septiguttata* ♂.

♂♀. Epipharynx distinct, excurved or nearly straight. Labrum on a plane with clipeus or inclining, separated by a suture which usually is indistinct ; laterally the labrum and the angle of the clipeus raised together into a prominent tubercle, which is not the case in any other genus of *Ludiinae* except *Carnegia*. Between this tubercle and the eye the deep genal groove. Genal process impressed along eye and scaled. Tongue longer than palpus, usually several times as long, particularly in ♂, not functioning as a sucking tube. Palpus short, not projecting beyond margin of frons (= clipeus), non-segmented, with constriction in middle indicating joint between first and second segments ; no third segment, but at apex a small groove. Frons narrower anteriorly than the eye is high.

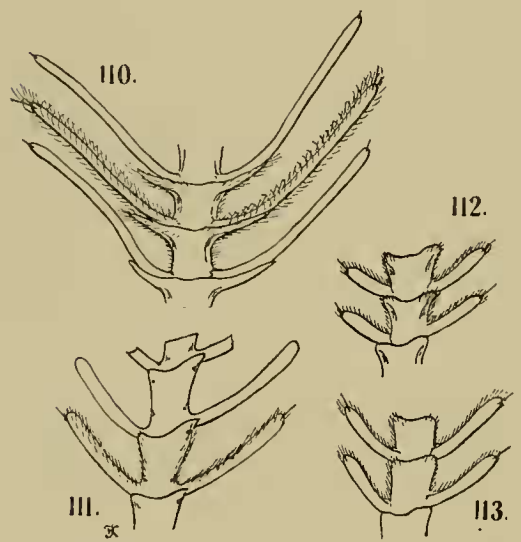


FIG. 110.—*Orthogonioptilum dollmani* ♀; segments 8 and 9 of antenna.
FIG. 111.—*Orthogonioptilum vestigiata* ♀; segments 8 and 9 of antenna.
FIG. 112.—*Orthogonioptilum incana* ♀; segments 8 and 9 of antenna.
FIG. 113.—*Orthogonioptilum incana* ♀; segments 8 and 9 of antenna.

Antenna in ♂ quadripectinate to two-thirds or beyond, 16 to 18 segments pectinate and 16 to 11 without branches, apical branch contiguous with basal branch following. In ♀ bipectinate to segments 17 to 21, the apical branches also present in the larger species, but not in *O. incana* ; 13 to 9 segments non-pectinate. In both sexes the distal segments short, strongly compressed ; the apical ventral angle of these segments projecting, bearing several sensory cones as in *Goodia* ; one or the other segment with only a single cone. In ♀ the branches with three or four short stiff setae at apex and one or two before apex (text-figs. 110–113).

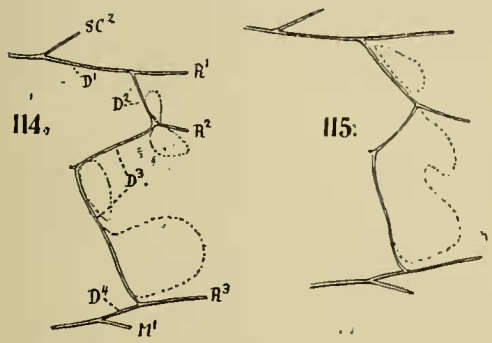
Epiphysis of foretibia large in ♂, reduced in ♀, but remaining long, being much larger than in any *Goodia*-♀♀. Spurs of mid- and hindtibia short, as in the allied genera. Tarsi with the spines reduced to short bristles, except the pair of apical spines of the fourth foretarsal of ♀. Sole of fifth segment scaled in all tarsi, in foretarsus of ♀ with a non-scaled lateral stripe studded with sensory hairs, which, however, do not form a dense mass. Lobe of paronychium long ; pulvillus large. Claw serrate.

Neuration : Forewing with four subcostals, all beyond cell, SC^1 off stalk of SC^{2+5}, SC^3 off SC^4. Discocellular D^1 about as long as D^2, which stands at right angles (or nearly) to D^3 and is straight or slightly incurved ; D^3 much longer and strongly incurved (text-fig. 154). For neuration hindwing, cf. text-figs. 114–117.

No organ of stridulation in ♀, but in most ♀♀ on underside of forewing near

tornus behind (SM^1) a patch or spot of semi-erect scales which are larger than and different in colour and shape from the surrounding scales. On forewing beneath and on hindwing above a basal patch of shining modified scales.

Sexes different in wing-contour. In ♂ forewing falcate, termen evenly incurved, posteriorly straight, tornus about rectangular in the larger species, obtuse and more or less strongly rounded in *O. incana*; anal angle of hindwing not produced inward. In ♀ apex of forewing more pointed, termen excurved; hindwing costally longer than in ♂, apex angulate or even lobate at SC^2 (= vein 7), anal angle produced inward, forming a more or less prominent lobe. Scaling in outer half of wings smoothes and much harder than in *Goodia*, the teeth of the scales much shorter and broader.



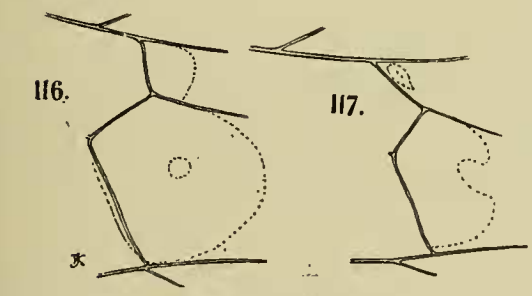


Fig. 114.—*Orthogonioptilum adustum* ♀; neuration of hindwing.

Fig. 115.—*Orthogonioptilum chalix* ♀; neuration of hindwing.

Fig. 116.—*Orthogonioptilum kahli* ♀; neuration of hindwing.

Fig. 117.—*Orthogonioptilum vestigiata* ♀; neuration of hindwing.

Genitalia: ♂. Eighth tergite medianly produced into a strongly chitinised process which is acuminate in centre and either simple or armed with spiniform teeth; this tergite projects far beyond tergites IX. + X. Eighth sternite simple, not projecting in centre as a lobe. Tenth segment peculiar; the homology of the various sclerites which have a dorsal position, and to which I shall refer as being portions of the tenth tergite, is by no means quite clear to me and requires further investigation; the dorso-lateral process probably is morphologically the enlarged upper end of the tenth sternite, but is functionally part of the tergite, a most interesting point well worth investigating. Tenth sternite without an infra-anal median process, being a low ridge which is obsolescent in middle and laterally runs upwards to join the dorsal sclerite, with which it is firmly connected. Clasper compact, strongly armed, different according to species. Penis-sheath stout, without armature.—— ♀. Genital sclerite large, posterior edge a more or less denticulate transverse ridge which is centrally sinuate; this sharp and rough ridge very different from the smooth, anteriorly concave, postvaginal ridge of *Goodia*; aperture large, subapical, central, or basal. Hair-scales around base of anal segment yellow, ochraceous, or tawny.

Early stages not known. Schultze mentions a bluish emerald-green larva as possibly belonging to *Carnegia mirabilis* (cf. this species, p. 326);

found on *Avona senegalensis*. It may have been the larva of a species of *Orthogonioptilum*.

In all species of *Orthogonioptilum* the antemedian line of the forewing, which is widely interrupted in *Goodia*, is continuous, less oblique than in *Goodia*, and widened at costa into a patch or large spot ; the line often indistinct in ♂. Collar (with the exception of *O. incana*) slightly paler than mesonotum in ♂, not in ♀.

Key to the species :

I. Antenna in ♂ quadripectinate to two-thirds, in ♀ quadripectinate with the apical branches short. On underside of forewing a pale, oblique stripe * from costa near apex straight to vein R^3, accompanied by a blackish stripe either on the distal side only or also on the proximal side ; tarsi ringed with creamy buff or grey.

A. Males (this sex not known of *O. adustum* and *O. chalix*).

(*a*) Greyish drab (more or less pale).

1. Apical portion of eighth tergite dentate and much broader than long ; harpe of clasper broad, dentate at dorsal and apical margins. With some ochraceous spots on underside . . . . . *O. adiegetum*

2. Eighth tergite as before ; harpe elongate-triangular, not dentate. Without ochraceous spots . . . . . *O. dollmani* (Pl. 2, fig. 1)

3. Eighth tergite not dentate, truncate, with small rounded median lobe *O. vestigiata*

4. Eighth tergite long, with long spiniform median projection and a lateral tooth . . . . . *O. deletum* (Pl. 2, fig. 9)

(*b*) Warm brown (cinnamon to russet) or sepia-colour.

5. Antemedian line broader on both wings than in all the following species. Fawn, inclining to vinaceous. (Eighth tergite not examined) . . *O. kahli*

6. Antemedian line thin. Warm brown. Apical process of eighth tergite dentate, with the sides rounded and the apex acuminate, recalling a poplar leaf, numerous bristles on convex dorsal portion . . . *O. prox* (Pl. 2, fig. 8)

7. Sepia brown ; antemedian and postdiscal lines indistinct on account of the dark general colour. Eighth tergite as before, apical tooth rather longer *O. monochromum*

8. Warm brown. Posterior vitreous spot on forewing large, irregularly reniform. Eighth tergite proximally to apical dentate portion with a large median tubercle . . . . . ? *O. brunneum* (Pl. 2, fig. 6)

B. Females (this sex not known of *O. deletum* and *O. monochromum*).

(*a*) Forewing below with a spot of modified scales near ternus in front of SM^2.

1. Median cavity of genital sclerite subapical. Fore- and hindwing beneath with conspicuous ochraceous spots in some of the niches of the postmedian line . . . . . *O. adiegetum* (Pl. 2, fig. 3)

2. Genital sclerite as before. No ochraceous spots on underside *O. dollmani* (Pl. 2, fig. 2)

3. Genital sclerite nearly as before. Antemedian and postdiscal lines, above, more or less indistinct (apart from costal patches of forewing) *O. adustum* (Pl. 2, figs. 14, 15)

* This stripe indistinct in *O. chalix*, which we know only from one imperfect specimen.

4. Cavity of genital sclerite in or before middle, apical margin of sclerite not sinuate; oblique apical line on underside of forewing greyish *O. kahli* (Pl. 2, fig. 16)

5. Genital sclerite as before, but apical margin sinuate in centre, lateral edge of cavity with tooth or tubercle. Oblique apical line on underside of forewing obsolescent . . . . . *O. chalix* (Pl. 2, fig. 5)

6. Genital sclerite as before, but apical margin rather strongly dentate; wall of cavity subcylindrical. Oblique apical line of forewing below conspicuous, cinnamon . . . . . *O. brunneum* (Pl. 2, fig. 13)

(*b*) No spot of modified scales on underside of forewing.

7. General colour cinnamon. Apical branches of pectinated antennal segments very distinct. In front of cavity of genital sclerite a conspicuous transverse ridge raised each side into a tooth or tubercle . *O. prox* (Pl. 2, fig. 12).

8. Much shaded with whitish grey. Apical branches of pectinated antennal segments quite short. No conspicuous transverse ridge in front of vaginal cavity *O. vestigiata* (Pl. 2, fig. 4)

II. Antenna in ♂ quadripectinate to four-fifths (of total length), in ♀ bipectinate; tarsi ringed with ochre yellow . *O. incana* (Pl. 2, figs. 7, 10, 11)

1. Orthogonioptilum adiegetum Karsch (1893) (Pl. 2, fig. 3 ♀).

♂. *Orthogonioptilum adiegetum* Karsch, *Berl. Ent. Zeits.* xxxvii. 1892. p. 501. no. 17. tab. 20. fig. 1 ♂ (1893, May) (Buea, Camerun).

Orthogonioptilum odiegetum (!), Rothschild, *Nov. Zool.* ii. p. 41 (1895).

♂. *Guillemeia tristis* Sonthonnax, *Ann. Labor. Ét. Soie*, ix. p. 158 (1899) (Camerun, coll. Oberthür); id., *Échange*, xvi. p. 31 (1900); id., *Essai Classif. Lép.* iv. p. 47. no. 1. tab. 26. fig. 1 ♂ (1904).

Dark markings more prominent than in the other species of this genus. Antemedian line strongly zigzag, taken as a whole evenly curved in ♂, while in ♀ it is much more distal between M^1 and M^2, forming here a double tooth. A shadowy dark band obliquely across median area, having the appearance of being a continuation of the antemedian line of the hindwing.

In ♂ three or four minute vitreous dots on forewing, in ♀ three larger and one or two small spots. From apex of forewing a pale line runs to R^2 or R^3, bordered with blackish brown on inner and outer sides, but more heavily on the terminal (= outer) side; the proximal dark border of this line continued backwards as a line or band, and the outer border of the apical line replaced further back by dark triangles which in the ♂ are separated from each other and vestigial, and in the ♀ form a dentate band. The niches of the postdiscal line on its basal side are partly filled in with ochraceous on the undersurface of both wings, these spots more numerous and more conspicuous in ♀.

In the ♀ in coll. Joicey (Pl. 2, fig. 3) the termen of the forewing is strongly convex, the apical lobe narrow and long; termen of hindwing sinuate below apical angle, which projects very distinctly. Antenna with 23 segments pectinate and 13 non-pectinate, the apical branches of segments 6 to 12 about as long as a segment. In both wings M^1 stalked with R^3, the stalk shorter in fore- than in hindwing (in ♂ M^1 from before cell-angle). *Upperside* of body and wings chestnut, densely shaded with purplish ceru-drab, with the exception of the submarginal band, an ill-defined curved patch on forewing surrounding the vitreous dots on the proximal and costal sides, and the streak which runs parallel

with costal margin of forewing to abdominal margin of hindwing, these markings mummy-brown and, like the terminal fringes, not shaded with ecru-drab.—— *Underside* of body and wings brighter chocolate than above; ochraceous spots very prominent on both wings. The spot of modified scales on forewing elongate-elliptical, dull ochraceous, its outer third blackish chocolate; the scales curved in S-shape, pointed, similar to text-fig. 148, *a* and *b*.

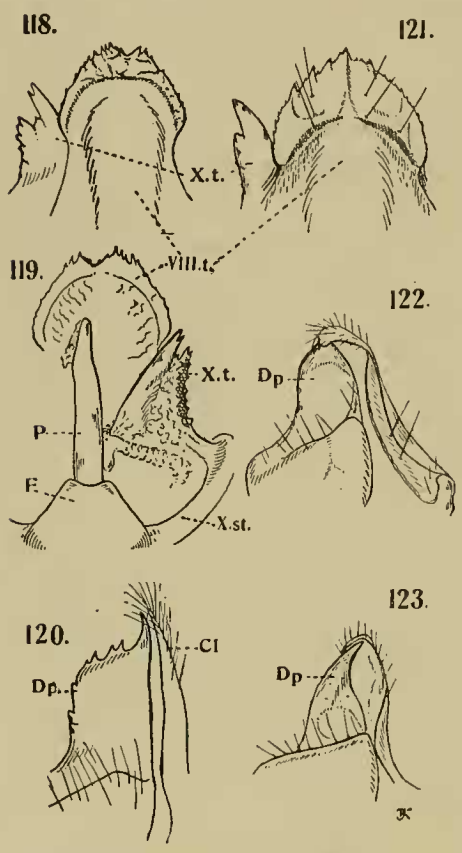


FIG. 118.—*Orthogonioptilum adiegetum* ♂; eighth tergite, dorsal aspect.
FIG. 119.—*Orthogonioptilum adiegetum* ♂; genitalia, ventral aspect.
FIG. 120.—*Orthogonioptilum adiegetum* ♂; clasper, inner side.
FIG. 121.—*Orthogonioptilum dollmani* ♂; eighth tergite, dorsal aspect.
FIG. 122.—*Orthogonioptilum dollmani* ♂; clasper, inner side.
FIG. 123.—*Orthogonioptilum dollmani* ♂; clasper, inner side, view vertical on apical lobes.

Genitalia: ♂. Eighth tergite (VIII. t., text-fig. 118) ending with a broad rounded process, which is dentate at the edges and acuminate, bearing in the paratype an asymmetrical apical sinus which is absent from the type. At each side of this process, but beneath it, the armature of the tenth tergite is visible. In a ventral aspect (text-fig. 119) the two large, very strongly chitinised, setiferous, bifid, supra-anal processes X. t. are found to be separated by a small median sclerite and connected laterally with the tenth sternite (X. st.) without a suture. The penis-sheath (P) slender; penis-funnel (F) broader proximally than long, its apex truncate-sinuate. The dorsal half (Dp) of the clasper (text-fig. 120) very broad, strongly dentate, ending with a long, curved tooth.

♀. Surface of genital sclerite convex in centre, this elevated part bearing the aperture, which is sub-apical; rim of aperture gradually lower distally and disappearing at the edge of the sclerite; this edge slightly denticulate, with a small median sinus.

Early stages not known.

Hab. Camerun; Spanish Guinea.

In Mus. Tring 1 ♂ from Nkolentangan, Spanish Guinea (G. Tessmann), received from the Berlin Museum.

In Mus. J. J. Joicey 1 ♀ from Bitje, Ja River, Camerun, 2,000 ft., dry season (G. L. Bates).

In Mus. Berlin 1 ♂ from Buea, Camerun.

In coll. Charles Oberthür 1 ♂ from Camerun.

2. **Orthogonioptilum dollmani** spec. nov. (Pl. 2, fig. 1 ♂, 2 ♀).

Probably a geographical form of *O. adiegetum*. Vein M^1 in both wings from cell in ♂ and from angle in ♀.

Both sexes above broccoli-brown shaded with grey, the lines prominent, the antemedian one heavier in ♀ than in ♂, costal spots conspicuous, markings in terminal area of both wings weaker than in *O. adiegetum*, in ♂ scarcely a trace of such markings on hindwing; the vitreous spots of forewing bounded on costal and proximal sides by a shadowy curved band of a dull tawny-olive tint, the oblique stripe situated between the antemedian and postdiscal lines below the lower cell-angle of the same colour, being less prominent and paler than in *O. adiegetum*. Costal margin of hindwing slightly pink. Termen of forewing of ♀ much less convex than in the preceding species, hindwing also less excurved below sinus; in ♂ anal angle more rounded than in ♂ *adiegetum*.——On *underside* the body, forewing except terminal area, and base of hindwing washed with pinkish chocolate, rest a cinnamomeous isabella colour. At costal bent of forewing outside postdiscal line a diffuse pale cloud; oblique pale apical line accompanied by a prominent black line on terminal side. In ♀ the space between discocellulars of forewing and postdiscal line, a spot below M^2 at inner side of this line, and on hindwing such spot or clouds below costa, outside discocellulars, and below M^2 dull raw umber colour, not ochraceous, and not much brighter than terminal area, in ♂ these spots practically absent.

Vitreous spots and antenna (text-fig. 110) as in *adiegetum*, the ♂ bearing three small vitreous dots on both wings.

Genitalia: ♂. Eighth tergite broader than in *O. adiegetum* (text-fig. 121). Supra-anal process X. t. narrower, less dentate. Penis-sheath much broader; penis-funnel apically not sinuate. Dorsal lobe of clasper (text-figs. 122, 123, Dp) elongate-triangular, acuminate, the apex curved ventrad and concealed in the clasper in a view vertical on the inner surface of the clasper (text-fig. 122).——♀. Genital sclerite (text-fig. 134) agreeing closely with that of *O. adiegetum*.

Hab. Rhodesia.

In Mus. Brit. one pair from Solwezi, N.W. Rhodesia, August 1917 (H. C. Dollman).

3. **Orthogonioptilum adustum** spec. nov. (Pl. 2, figs. 14 ♀, 15 ♀).

♀. Markings as in ♀ *O. adiegetum*, but much less prominent. Antenna with 20 segments pectinate and 10 non-pectinate, longest branches as long as four segments. Vitreous spots essentially as in *O. adiegetum* (cf. figs. on Pl. 2), remaining more or less completely separate; in hindwing the anterior spot directly above the second, while in the species following hereafter the upper spot has a more proximal position. This difference is due to a difference in neuration: in *O. adustum* ♀ the cross-vein D^2 is short and but slightly oblique, and D^3 is broken at a right angle (text-fig. 114). Subtornal spot of modified scales present on underside of forewing.

Genital sclerite (text-fig. 136) similar to that of *O. adiegetum*, but the convex median area longer, the anterior edge of the cavity higher, continued apicad as a sharp ridge which ends in the submedian tooth of the apical edge of the sclerite. Seen from the side the median portion of the sclerite has the appearance of an obliquely truncate cone.

The two specimens we place here differ considerably in colour. The example in the Tring Museum (type, Pl. 2, fig. 15) is tawny russet (faded ?), much shaded with ecru-drab ; on the underside the niches of the postdiscal line, especially outside the vitreous spots, a somewhat brighter ferruginous tint, lighter than the spot of modified scales. This spot small, the outer scales olivaceous black, forming a rather well-defined halfring (as portion of the postdiscal crenate line). The modified scales broader than in *O. adiegetum*, the apex shorter and in many scales divided up into long, narrow teeth. In both wings M^1 from cell near angle.

The ♀ in coll. Joicey is blackish olive shaded with ecru-drab ; on underside the pale apical line of forewing very prominent ; spots outside the vitreous marks dull ochraceous, vestigial on hindwing, three on forewing of which the posterior one is the most conspicuous. Patch of modified scales elliptical, about 2·5 × 4 mm., cinnamomeous, edged with black all round, a few scattered black scales in outer half of spot ; the great majority of the modified scales divided into a number of slender apical teeth. Above the patch a small pale ochraceous spot bounded on distal side by a black lunule (portion of postdiscal line). Genital sclerite as in the Tring specimen, except that the apical edge bears about halfway to the sides a small tooth which is barely indicated in the Tring example. M^1 of both wings from cell-angle.

Hab. Congo.

In Mus. Tring 1 ♀ (type) from Coquilhatville, Congo, at light on board the *President Urban*, 8 to 9 p.m., October 16, 1905 (Wailbroeck), received in exchange from the Royal Museum, Brussels.

In coll. Joicey 1 ♀ from Ituri River, halfway between Avakubi and Penghe, Belgian Congo, May 1920 (T. A. Barnes).

4. **Orthogonioptilum deletum** spec. nov. (Pl. 2, fig. 9 ♂).

♂. In colour similar to *O. vestigiata*, but more olivaceous isabella colour, markings less distinct, except the two costal spots of the forewing belonging to the antemedian and postdiscal lines. Forewing not quite so strongly falcate as in *O. vestigiata* ; from antemedian costal spot backwards an ecru cloud, similar shading in submarginal region ; pale and dark oblique apical streaks vestigial ; two transparent dots and rudiment of a third ; niches of postdiscal line not differently coloured from rest of disc, or faintly russet.——Hindwing with three vitreous dots, of which only the posterior one is distinct in the specimen figured.

On *underside* the forewing shaded with dark ecru-drab from base to or beyond apex of cell and to tornus ; apical oblique pale and dark streak visible but not prominent ; subapical costal triangular area pale wood brown or fawn ; hindwing except the darker termen the same tone, paler at abdominal margin.

Antenna with 17 or 18 segments quadripectinate and 11 or 12 non-pectinate.

Genitalia : Process of eighth tergite (VIII. t., text-fig. 127) much narrower than in *O. vestigiata* and *O. prox*, ending with a long spiniform tooth ; middle convex, lateral margin elevate, smooth, ending with a short tooth. Tenth tergite (X. t., text-fig. 131) represented by two strongly chitinised sclerites which are separated from one another by a wide median gap ; each sclerite longer than broad, roughly oblong, with the apex sinuate, the inner apical angle prolonged

as a spiniform process and the outer angle and outer edge obtusely dentate. Penis-funnel (F) a large, transversely wrinkled, dorsally open half-cylinder which is somewhat angulate in middle. Clasper (Cl) divided by an apical slit into two lobes, both strongly chitinised, the ventral one the longer and narrower of the two, concealing the broader and shorter dorsal lobe in a view from the ventral side (if the claspers are closed), its apex black and rounded. The dorsal lobe pointed at apex, its inner surface concave (Dp, text-figs. 128, 129).

Length of forewing: 30 and 34 mm.

Hab. Bibianaha, 70 miles N.W. of Dimkwa, Gold Coast, 700 ft., October and November 1910 (H. G. F. Spurrell); 3 ♂♂ in Mus. Brit.

5. **Orthogonioptilum prox** Karsch (1893) (Pl. 2, figs. 8 ♂, 12 ♀).

♂. *Orthogonioptilum prox* Karsch, *Berl. Ent. Zeits.* xxxvii. p. 502 footnote (1893, May) (Malimba).

♀. *Carnegia geniculipennis* Strand, *Iris*, xxiv. p. 185 (1910) (N.W. Camerun).

Prevalent tone of colour a warm brown.

♂. Varying from mummy-brown to dull hazel, the niches of the post-discal line brightest, middle of forewing above with darker shadowy band or cloud, which widens costad and narrows behind, underside of hindwing sometimes clayish ochraceous. In contour of wings and markings similar to *O. vestigiata*, the termen of forewing a little less incurved, and the oblique apical streak less distinct above and below. Both wings with one to three small vitreous dots. Antenna with 17 segments quadripectinate and 12 to 15 non-pectinate.

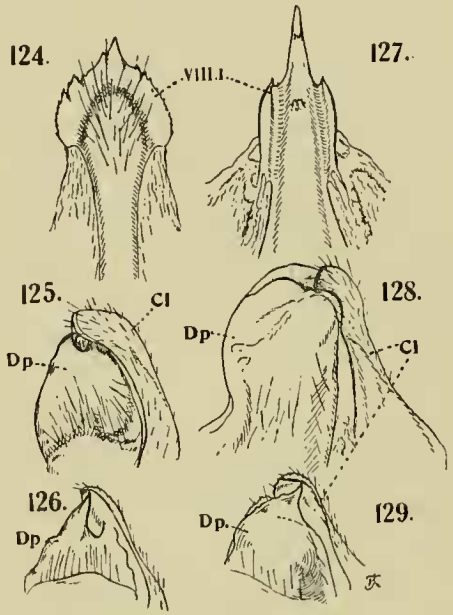


Fig. 124.—*Orthogonioptilum prox* ♂; eighth tergite, dorsal aspect.

Fig. 125.—*Orthogonioptilum prox* ♂; clasper, inner side.

Fig. 126.—*Orthogonioptilum prox* ♂; clasper, inner side, view vertical on apical lobes.

Fig. 127.—*Orthogonioptilum deletum* ♂; eighth tergite, dorsal aspect.

Fig. 128.—*Orthogonioptilum deletum* ♂; clasper, inner side.

Fig. 129.—*Orthogonioptilum deletum* ♂; clasper, inner side, view vertical on apical lobes.

Genitalia: Eighth tergite (text-fig. 124) with a broad process which is rounded-dilated before the apex, the apex itself pointed, the sides of the dilated portion irregularly denticulate and the dorsal surface centrally studded with bristles; this leaf-like apical portion is continued proximad by a very long convex strip of chitin, with parallel sides and extending to the base of the segment, the sides of the segment being membranous. Clasper, in ventral aspect narrow and apically curved inwards, but when detached or bent sideways and examined from the inner side, the two portions which are present in all species of *Orthogonioptilum* become visible; text-fig. 125 represents the clasper as seen when

viewed vertically to the centre of the inner surface: the main distinction from *O. deletum* is in the shape of the dorsal lobe (Dp); this lobe is smaller than in *O. deletum* and ends with a much longer pointed process, of which the ventral edge recurves apicad, while in *O. deletum* this edge continues basad; compare text-figs. 126 and 129, which represent views vertical to the apical lobes. Penis-funnel (F) much smaller than in *O. deletum*. The tenth tergite (text-fig. 130) with a small central hump (the true X. t. ?), and on each side, firmly attached to the tenth sternite, a pyramidal process, very strongly chitinised, black, similar to the process of *O. deletum*, but with the lateral dilatation barely indicated. These processes can be examined from the upperside in both species when the scaling of the eighth tergite is moistened and brushed sideways.

♀. The ♀ described by Strand as *geniculipennis* and the one figured Pl. 2, fig. 12, probably belong here. No spot of modified scales on underside of forewing. Apical branches of pectinated segments of antenna rather short, all shorter than the segments are long, longest proximal branches as long as only three segments.

General colouring cinnamon (Ridgway, *Nomencl. Colours*, iii. 20), proximal and distal areas above somewhat shaded with grey, median area of forewing rather deeper in tone, tawny-olive; antemedian line and postdiscal one of forewing commencing with a large dark brown costal spot bounded by greyish white scaling. Forewing with a large vitreous ring open in front, and above it three small spots, of which the second and third are separated by the cross-vein only; M^1 from cell.

Apical edge of genital sclerite (text-fig. 137) deeply sinuate in centre, the sinus flanked on each side by a large triangular tooth. Aperture proximal; in front of the cavity in which the aperture is situated a prominent transverse ridge ending each side with a large tubercle.

Early stages not known.

Hab. Gold Coast, Nigeria, Camerun.

In Mus. Tring 3 ♂♂ from the Gold Coast: Abossi (Dr. J. J. Wilson), and Kumasi at light (Dr. Sander).

In Mus. Brit. 4 ♂♂ from Bibianaha, 70 miles N.W. of Dimkwa, Gold Coast, 700 ft., November 1910 (H. G. F. Spurrell), and one ♀ from Old Calabar.

In Mus. Berlin a ♂ and 2 ♀♀ from Camerun.

6. **Orthogonioptilum monochromum** Karsch (1893).

♂. *Orthogonioptilum monochromum* Karsch, *Berl. Ent. Zeits.* xxxvii. p. 502. no. 18. tab. 20. fig. 3 ♂ (1893, May) (Buea, Camerun).

♂. Probably a deep and uniformly coloured specimen of *O. prox*, similar in outward appearance to *O. deletum*. Genitalia similar to those of *O. prox*; tip of eighth tergite armed with a spiniform tooth which is slightly longer than in the eight specimens of *prox* I have examined; upperside of the dentate median process of this tergite setiferous, as in *O. prox*. The figure given by Karsch, *l.c.*, is too olivaceous; the type (unique) is of a warmer brown, with a very slight olive tone. The markings are all very weak on account of the deep ground-colour.

Hab. Camerun.

One ♂ in Mus. Berlin.

7. **Orthogonioptilum brunneum** spec. nov. (Pl. 2, fig. 13 ♀).

♀. In colouring and wing-contour very similar to *O. prox*-♀. Body and wings olivaceous russet, a deeper and warmer brown than in *prox*-♀. Forewing on the outer side of the postdiscal line at costa and posteriorly shaded with grey, likewise the median area and admarginal region of the hindwing, antemedian line of forewing bordered with grey. Forewing with a vitreous ring bearing a brown dot, in front of the ring three vitreous spots; hindwing with an irregular vitreous halfring and above it a dot.——On *underside*, which is tawny olive (Ridgway, *Nomencl. of Colours*, iii. no. 17), an oblique streak of this colour from costal margin close to apex straight to R^3, bounded on distal side by a broad stripe and on basal side by a less conspicuous one, both blackish;

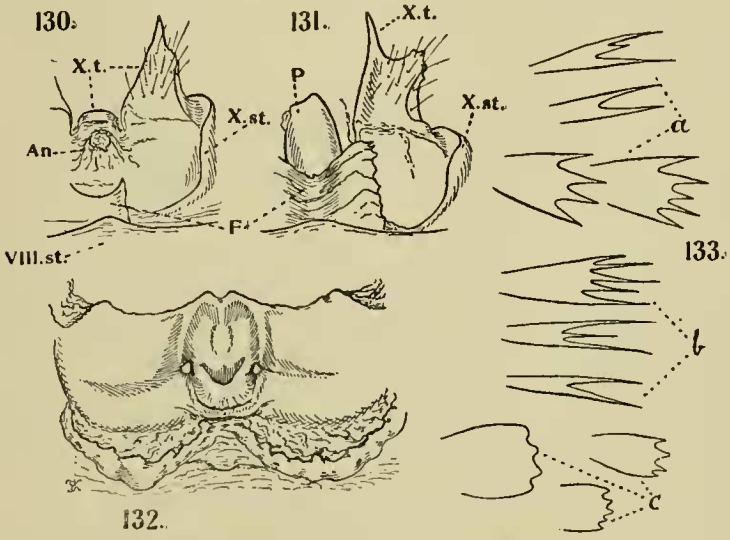


Fig. 130.—*Orthogonioptilum prox* ♂; genitalia, ventral aspect, claspers removed.
Fig. 131.—*Orthogonioptilum deletum* ♂; genitalia, ventral aspect, claspers removed.
Fig. 132.—*Orthogonioptilum chalix* ♀; genital sclerite.
Fig. 133.—(*a*) Four white scales from apical area of forewing above of *O. chalix* ♀;
(*b*) Three white scales from fringe of forewing above of *O. chalix* ♀;
(c) Three white scales from apical area of forewing above of *O. brunneum* ♀.

before tornus a small spot of modified scales, these scales moderately curved in S-shape, nearly all sharply pointed, most of them dark hazel, a few blackish, the spot ill-defined. No conspicuous bright spots in the niches of the postdiscal line, the niches outside the transparent spots only slightly brighter than the outer half of the wing. Postdiscal line of hindwing commencing with a rather large transverse spot. White scales at apex of forewing, above, with short teeth (text-fig. 133, *c*).

Antenna with 19 segments pectinate and 14 non-pectinate, the apical branches of the pectinated segments very distinct, those of segments 6 to 12 as long as or rather longer than a segment, longer than in *prox*-♀; longest proximal branches nearly as long as four segments. Angle formed in forewing by crossveins D^2 and D^3 less than 90°.

Genital armature : The edge of the genital sclerite sharply dentate (text-fig. 135) ; aperture round, wall of cavity subcylindrical, lying much above the level of the sides of the sclerite, somewhat uneven ; edge of aperture fading away anad into the two median teeth of the apical margin.

♂. The ♂ figured Pl. 2, fig. 6 may belong here. It differs from *O. prox*-♂ in the larger vitreous spots (cf. figs.) and in the eighth abdominal tergite bearing a large truncate tubercle in middle a short distance from the dilated apical portion of the process. The genitalia agree otherwise so well with those of *O. prox* that I am inclined to regard the tubercle, which is not quite symmetrical in shape, as a malformation, possibly due to a local disturbance in the chrysalis. The specimen came with 4 ♂♂ of *O. prox*, which it resembles in colour.

Hab. Gold Coast.

In Mus. Brit. 1 ♀ from Takwa, Gold Coast (type) ; and a ♂ doubtfully belonging here from Bibianaha, Gold Coast, 700 ft., October 1911 (H. G. F. Spurrell).

8. **Orthogonioptilum kahli** Holland (1921).

♂. *Goodia kahli* Holland, *Proc. Ent. Soc. Washingt.* xxiii. p. 99 (1921) (Efulen, Camerun).
♂. *Goodia* (*Orthogonioptilum*) *kahli* id., *l.c.* tab. 7 (1921).

♂. According to the figure and description published and a photograph kindly supplied by the author, the specimen is similar to *O. prox*, but has the transverse lines more pronounced, particularly the antemedian line ; this line broader also on hindwing than in *O. prox*.

♀. A ♀ in coll. Joicey, represented Pl. 2, fig. 16, probably belongs here. In colour and pattern, apart from the very different vitreous spots, it looks like a small edition of *O. adiegetum*. Sepia colour, shaded with grey in parts, a large grey cloud on forewing below costa outside the postdiscal line rather sharply defined, triangular, accentuated at costal margin by a nearly white spot ; anterior half of terminal area of forewing as dark sepia as centre of wing.

Vitreous marks enlarged : on forewing second and third separated from each other and from the fourth by a vein only, fourth large, triangular, enclosing a scaled dot, proximal side of spot somewhat rounded, the lower angle slightly produced, a small vitreous spot in the cell-angle being confluent with the large spot. In hindwing the three posterior spots merged together to form a large irregular ring enclosing a scaled dot, above the ring and separated from it only by the vein is placed the upper spot, which is traversed near its basal margin by the second cross-vein.

On *underside* the black postdiscal line very prominent on the nearly uniform sepia ground ; pale oblique apical streak of forewing without distinct black proximal border ; a slight tint of ochraceous between vitreous spots and postdiscal line on forewing, barely indicated on hindwing. Spot of modified scales ochraceous, traversed near its outer margin by a black lunule (postdiscal line) ; the scales broad, inclining distad, slightly bent in S-shape, narrowed apically, but apex divided up into a number of teeth.

Antenna with 18 segments pectinate (tip broken off) ; the branches rather stouter than usual, the apical branches quite short, though distinct (nearly as in text-fig. 111). Cross-veins D^1 and D^2 of hindwing short (text-fig. 116), D^3

rectangularly elbowed, M^1 from just beyond cell-angle. In forewing the angle formed by D^2 and D^3 much larger than 90°.

Genital armature: Vaginal sclerite smooth, glossy, apical edge not very sharp, neither sinuate nor dentate; frontal margin of aperture raised as a transverse smooth ridge, which is deeply sinuate in middle and slants down laterally; base of sclerite marginate, the elevate margin low in middle, but more raised laterally (text-fig. 138).

Hab. Camerun.

Two ♂♂ in coll. Holland from Efulen, Camerun, May and October.

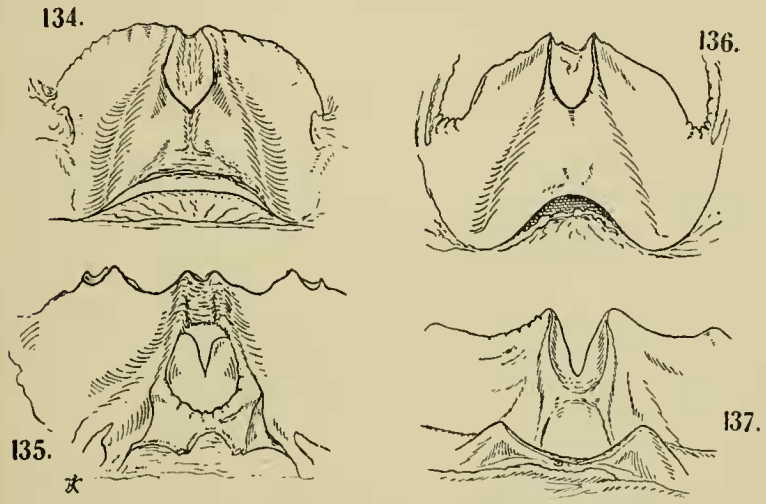


Fig. 134.—*Orthogonioptilum dollmani* ♀; genital sclerite.
Fig. 135.—*Orthogonioptilum brunneum* ♀; genital sclerite.
Fig. 136.—*Orthogonioptilum adustum* ♀; genital sclerite.
Fig. 137.—*Orthogonioptilum prox* ♀; genital sclerite.

One ♀ in coll. J. J. Joicey from Bitje, Ja River, Camerun, 2,000 ft., October —November 1913, wet season (G. L. Bates).

9. **Orthogonioptilum chalix** spec. nov. (Pl. 2, fig. 5 ♀).

♀. Only one imperfect specimen known to me. Not unlike the ♀ of *O. incana*, but the remnant which is left of the antennae proves the species to have the apical branches of the pectinated segments quite distinct. Upperside dull hazel, underside vinaceous-cinnamon, the colouring probably not constant. Forewing slightly shaded with grey above, both lines present, but not prominent, no oblique apical line, but instead a shadowy, undulate, submarginal band from costa towards tornus, termen clayish outside this band; three vitreous marks, second divided by the cross-vein D^2, third a halfring open on the distal side, widened behind, entering lower cell-angle.——Hindwing with two vitreous spots, the upper one small, second large, sinuate on outer side; apical angle of wing prominent; postdiscal line distinct, but rather weak.

On *underside* the transparent spots as above, except that on the right forewing

the large spot is a complete ring enclosing an elongate scaled spot. Transverse lines not prominent, their costal spot diffuse, on forewing some slight grey shading along the line, particularly near costa. Spot of modified scales present, blackish brown to the naked eye, but in reality dark hazel, darker proximally than distally, the scales densely packed. The base and apex of a scale curved distad and the central portion erect, but the S-shape not so strongly pronounced as in text-fig. 148, *a* and *b* (*O. dollmani*), apex acuminate and dentate (text-fig. 148 *e*, a scale flattened).

The scales of the upper layer in both wings with longer teeth than in the previous forms. For comparison we figure the white scales placed near apex

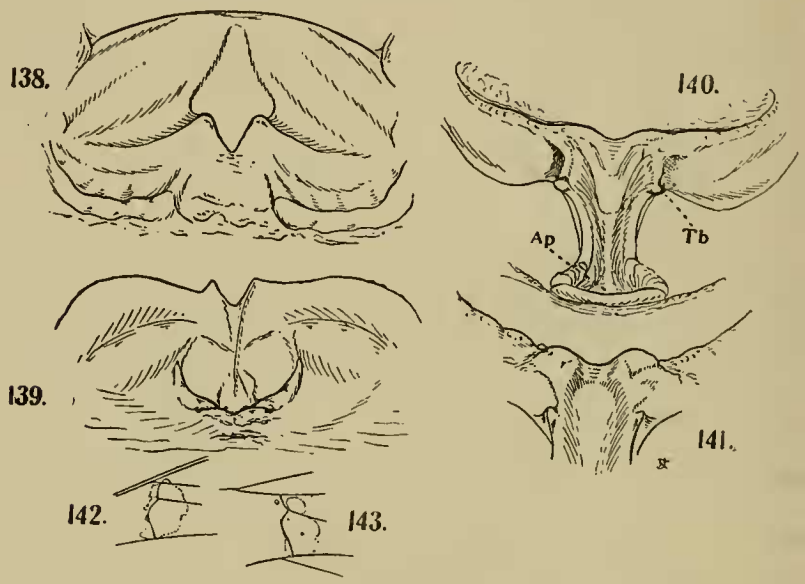


FIG. 138.—*Orthogonioptilum kahli* ♀; genital sclerite.
FIG. 139.—*Orthogonioptilum vestigiata* ♀; genital sclerite.
FIG. 140.—*Orthogonioptilum incana* ♀; genital sclerite.
FIG. 141.—*Orthogonioptilum incana* ♀; genital sclerite.
FIG. 142.—*Orthogonioptilum incana* ♀; vitreous spots of forewing of type of "*servatia* Weym."
FIG. 143.—*Orthogonioptilum incana* ♀; vitreous spots of hindwing of type of "*servatia* Weym."

of forewing above (and in addition some scales of the terminal fringe) of the present species (text-fig. 133) and the corresponding white scales of *O. prox*-♀. In both wings M^1 from cell near angle; D^1 of hindwing as long as D^2, angle of D^2 very obtuse (text-fig. 115); in forewing the angle formed by D^2 with D^3 acute.

Genital armature: Apical edge of vaginal sclerite (text-fig. 132) slightly sinuate in centre, feebly denticulate, in front of cavity at each side a conical hump. Basal margin incurved centrally, excurved and upturned laterally, a curved, obtusely denticulate, rough basal ridge being formed each side.

Hab. Dar Runga and Dar Kouti, Shari-Tchad Protectorate, Ironstone Plateau, 2,000 ft., 22° E., 10° N. (Karl Kumm), 1 ♀ in Mus. Brit.

10. **Orthogonioptilum vestigiata** Holland (1893) (Pl. 2, fig. 4 ♀).

♂. *Goodia vestigiata* Holland, *Ent. News*, iv. p. 180. no. 20. tab. 9. fig. 1 ♂ (1893) (Ogové River) Strand, *Iris*, xxiv. p. 188 (1910) (" very probably an *Orthogonioptilum* ").

♀. *Ludia servatia* Weymer, *Iris*, xxii. p. 14. no. 9 (1909) (Bipindi, Camerun ; in coll. Richelmann).

♂. Upperside of body and wings wood brown shaded with ecru-drab, which gives the insect a decided grey appearance. Collar paler than mesonotum. The niches of the postdiscal line of the forewing, a patch in which the transparent dots are placed on both wings, and the two or three niches outside these dots on hindwing creamy buff on upperside and darker buff below.——On *underside* the costal edge of forewing for the greater part ferruginous ; abdominal area of forewing and base of hindwing slightly tinged with pink ; terminal fringe of hindwing dull ferruginous or tawny. Antenna with 17 segments quadripectinate and 14 or 15 non-pectinate.

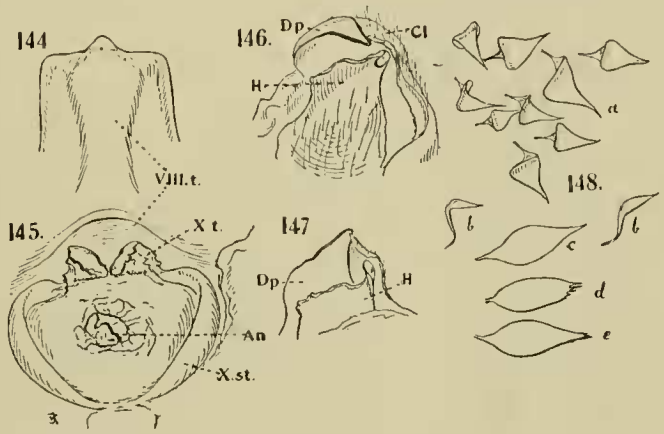


Fig. 144.—*Orthogonioptilum vestigiata* ♂ ; eighth tergite, dorsal aspect.

Fig. 145.—*Orthogonioptilum vestigiata* ♂ ; genital, ventral aspect, claspers removed.

Fig. 146.—*Orthogonioptilum vestigiata* ♂ ; clasper, view vertical on centre.

Fig. 147.—*Orthogonioptilum vestigiata* ♂ ; clasper, view vertical on apical lobe.

Fig. 148.—(*a*) Scales of plume-spot (*in situ*) of *O. dollmani* ♀ ; view vertical on plane of wing.
(*b*) Two such scales in lateral aspect (*in situ*) of *O. dollmani*.
(*c*) A scale pressed flat.
(*d*) A corresponding scale from plume-spot of *O. incana* ♀.
(*e*) A corresponding scale from plume-spot of *O. chalix* ♀.

Genitalia: Eighth tergite with a broad, truncate, non-dentate process, which bears a median lobe slightly variable in length and shape (text-fig. 144), the upper surface of the sclerite medianly convex. Above the anus (An, text-fig. 145) the anal tergite represented by two short, obtuse, stout, heavily chitinised sclerites, which are separated from each other by a narrow and deep incision and are firmly joined to the subcircular low ridge which is homologous to the tenth sternite (X. st.). Clasper (Cl) broad, apically divided by a deep slit into a hairy ventral lobe (Cl) and a strongly chitinised, black, glossy, acuminate dorsal process (Dp) ; on the inner surface of the clasper there is a broad sclerite, which is studded with bristles proximally and terminates with a curved, somewhat spathulate process (H, text-fig. 146, view vertical on centre of inner surface ; text-fig. 147, view from innerside vertical on surface of apical lobes).

♀. We think the ♀ described as *servatia* by Weymer is the ♀ of *O. vestigiata* : General colouring ecru-drab to whitish grey. Apical branches of pectinated

segments of antenna quite short, nearly as in *O. incana*-♀. On *underside* of forewing no spot of modified scales, and pale subapical line whitish. Vitreous spots large, forming one large patch in forewing ; cf. sketches (text-figs. 142, 143) taken from type of *servatia*. The specimen is much worn.

A ♀ in coll. Joicey, in rather better state of preservation, probably also belongs here (Pl. 2, fig. 4). *Upperside* fawn colour, *i.e.* a warm brown shaded with ecru-drab ; centre of forewing dull walnut-brown, antemedian line indistinct (worn), placed in a faint ecru-drab band ; postdiscal line thin and weak ; no distinct oblique apical streak ; terminal area slightly brownish below apical lobe, with feeble traces of brown submarginal blotches farther back. A large vitreous ring, enclosing a scaled spot, in front of the ring three vitreous spots (cf. Pl. 2, fig. 4).——On hindwing the postdiscal line more distal than in all the other large species (with sub-quadripectinate antenna in ♀), being in centre only a little nearer to the large vitreous spot than to the terminal margin ; the niches of this line very slightly brighter brown, as is also the case on the forewing. Two vitreous spots, the posterior one large, sinuate on distal side, the other small, obliquely above it. D^2 strongly oblique, angle of D^3 very obtuse (text-fig. 117) ; in forewing the angle formed by D^2 with D^3 somewhat less than 90°.

Underside drab (Ridgway, *Nomencl. of Colours*, iii. 18), shaded with fawn colour along the postdiscal line. On forewing a clayish oblique apical streak from costal margin to R^3, with a faint dark border on distal side, terminal area bounded by this streak and the postdiscal line dull vandyke brown (Ridgway, *l.c.* iii. 5) ; postdiscal line faint, slightly more prominent on hindwing, the costal spot with which the line commences diffuse and obsolescent on both wings ; the niches of the line tinted with ochraceous on forewing outside the large vitreous ring only, with a trace of the same colour in the two cellules above it, on hindwing a row of five diffuse but distinct ochraceous spots from R^1 to SM^2 and a trace of a spot before R^1 ; postdiscal line of hindwing in front of R^3 5 mm. from vitreous spot and 7 mm. distant from fringe.

Antenna with 16 segments bipectinate and 13 non-pectinate in Mr. Joicey's specimen, the numbers being about 19 and 16 in the type of *servatia* ; the longest branches as long as two segments only, the apical branches in both specimens very short (text-fig. 111), even shorter than in the ♀ we have placed with *O. kahli*.

Genital armature of type of *servatia* not visible except the apical margin of the vaginal plate ; this margin is centrally incurved and does not bear any prominent teeth. In the specimen in coll. Joicey (text-fig. 139) the edge of the sclerite is very sharp, rounded laterally, sinuate in centre, with a tooth flanking the sinus on each side. Cavity extending to near base ; frontal margin of cavity raised ; sides of sclerite uneven.

No spot of modified scales near tornus of forewing beneath.

Early stages not known.

Hab. Gold Coast ; Camerun ; Ogové River.

In Mus. Tring 3 ♂♂ from Prestea, 75 miles inland from Sccondi, Gold Coast.

In coll. Holland a ♂ from the Ogové River.

In coll. Richelmann 1 ♀ from Bipindi, Camerun.

In coll. Joicey 1 ♀ from Bitje, Ja River, Camerun, October—November 1912 (G. L. Bates).

11. **Orthogonioptilum incana** Sonthon. (1899) (Pl. 2, figs. 7 ♂, 10 ♀, 11 ♂).

♀. *Guillemcia incana* Sonthonnax, *Ann. Labor. Ét. Soic*, ix. p. 12 (Separ.). tab. 3. fig. 5 (1899) (M'Pala, Tanganyika); id., *Échange*, xvi. p. 31 (1900); id., *Essai Classif. Lép.* iv. p. 48. no. 2. tab. 26. fig. 2 (1904).

♀. *Holocera pancratia* Weymer, *Iris*, xvi. p. 232. no. 10. tab. 2. fig. 8 (1903) (Lindi).

♂. *Goodia septiguttata* Weymer, *l.c.* xxii. p. 14. no. 8 (1909) (Ilonga, Usambara).

♂. *Orthogonioptilum septiguttata*, Strand, *ibid.* xxiv. p. 188 (1910).

♀. *Ludia* (?) *incana*, id., *l.c.* (1910) ("*incana* probably a *Ludia*").

The smallest species known. Tornus of forewing more oblique than in any of the previous species, particularly in the ♀. Tarsi ringed with black and ochre-yellow. Colour of body and wings very variable in both sexes. ♀ with spot of modified scales on underside of forewing.

♂. Clayish buff, vinaceous cinnamon, hazel, dark liver-brown, or grey, sometimes with prominent vinaceous shading, underside more uniform than upper. Forewing with four vitreous dots, of which 1, 2, and 4 are arranged in a line, spot 3 being more proximal and often obsolescent. Hindwing with three vitreous dots in a triangle, the proximal dot and sometimes also the upper one obsolescent. Two lines as in the previous species, antemedian one often much reduced in distinctness, sometimes both almost obliterated; as a rule the lines of the forewing bordered with greyish white, the antemedian line on the proximal side and the postmedian one on the distal side, but this whitish scaling sometimes absent.

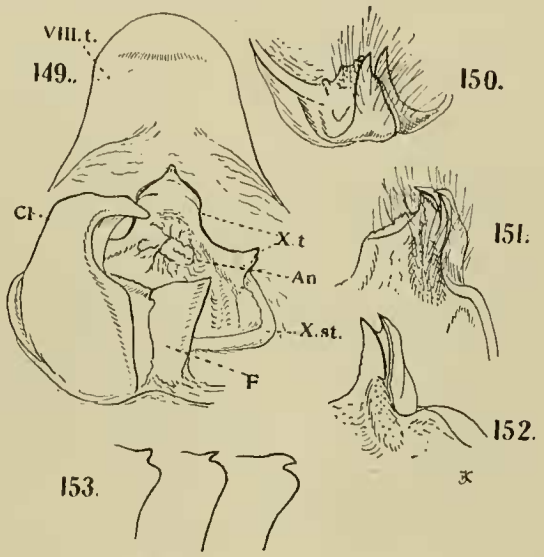


Fig. 149.—*Orthogonioptilum incana* ♂; genitalia, ventral aspect.

Fig. 150.—*Orthogonioptilum incana* ♂; apex of clasper, from anal side.

Fig. 151.—*Orthogonioptilum incana* ♂; clasper, inside, view vertical on centre.

Fig. 152.—*Orthogonioptilum incana* ♂; clasper, inside, view vertical on apical lobes.

Fig. 153.—*Orthogonioptilum incana* ♂; penis-funnel (of three specimens).

Antenna quadripectinate to near tip, 21 or 22 segments pectinate, 8 to 11 simple.

♀. Drab, wood brown, fawn, reddish chocolate or pinkish cinnamon rufous, the basal and terminal areas shaded with whitish grey to a more or less great extent, this whitish scaling condensed along the ante- and postmedian lines. Forewing with three vitreous spots, the upper one smallest, the second penetrating into upper cell-angle, usually incised on outer side, the third large, triangular, entering lower cell-angle and enclosing a scaled dot, which is often connected with

the disc, in which case the third spot has more or less the shape of a horse-shoe.—— On hindwing two vitreous spots, the upper small, sometimes absent, the second an irregular halfring, of which the upper arm sometimes is a separate spot. For neuration, cf. text-figs. 154, 155.

Antenna of ♀ with shorter pectination than in any of the previous species, bipectinate to segment 18, the last 11 or 12 segments simple ; the apical branches of the pectinated segments usually scarcely indicated (text-fig. 113), sometimes slightly more distinct (text-fig. 112). Spot of modified scales present on underside of forewing near tornus large in all specimens we have seen, ochraceous, chestnut, walnut, mummy-brown or brick-red, darkest distally, usually the dark scales forming a well-defined crescent ; the scales of the spot densely packed, less pointed than in the previous forms, all or practically all dentate (text-fig. 148, *d*), in a dwarfed (underfed) specimen these scales broader than usual and less erect.

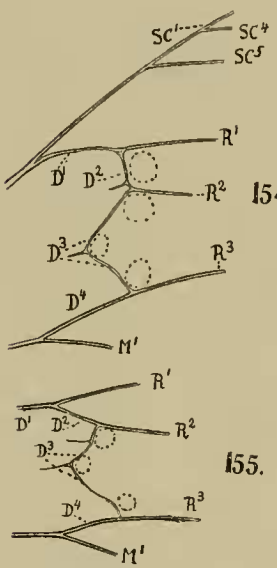


FIG. 154.—*Orthogonioptilum incana* ♂ ; neuration of forewing.

FIG. 155.—*Orthogonioptilum incana* ♂ ; neuration of hindwing.

Genitalia : ♂. Eighth tergite (VIII. t., text-fig. 149) with a very broad, rounded, apical lobe, of which the sides are sometimes curved in ; proximally to centre a median tubercle. Tenth tergite a strongly chitinised, black, transverse sclerite which bears a median lobe of variable width and length and at the lateral angles a sharp tooth, which is sometimes bifid ; the median lobe is sinuate-bidentate in a specimen in the British Museum labelled Natal Museum, Maritzburg, and which possibly represents a geographical form (shape of hindwing slightly different, Pl. 2. fig. 7). Tenth sternite, as in the other species of *Orthogonioptilum*, a low ridge. Clasper (Cl), in ventral aspect (text-fig. 149) narrowing apicad, with the apex curved inward. When viewed from the anal or inner sides the clasper is seen to be divided into two sharply pointed apical lobes (text-figs. 150–152).

Penis-funnel (F) peculiar, dorsally open, sides nearly flat and ventrally meeting in a carina, which is excised before reaching the apical margin, an apical hook of variable size being formed (text-fig. 153), sometimes the carina slightly denticulate ; the hook longest in the above-mentioned specimen from the Natal Museum. Penis-sheath broad, flattened.——♀. Edge of genital sclerite incurved in centre (text-figs. 140, 141), the sinus sometimes flanked by two short rounded lobes or even by two sharp teeth ; aperture (Ap) always basal, with a low, submembranous ridge in front ; centre of sclerite elevate, a depression or channel running from the aperture to the apical margin ; the sides of this channel raised at about one-third the way to the apex into a tubercle (Tb) of variable size.

Length of forewing : ♂, 24 to 29 mm. ; ♀, 25 to 43 mm.

Hab. West side of Lake Tanganyika to Usambara, southward to Salisbury, Rhodesia, probably extending farther south and north-east.

In Mus. Tring 1 ♂, 2 ♀♀ from Salisbury (J. O'Neil).

In Mus. Brit. a series of both sexes from Mt. Mlange, Nyasaland, March and October, and Petauke, East Loangwa district, 2,400 ft., January (S. A. Neave); Solwezi, Kashitu, and Mwenga, N.W. Rhodesia, August, September, November, and December (H. C. Dollman). Also 1 ♂ labelled Natal Museum, Maritzburg.

In Mus. J. J. Joicey 3 ♀♀ from Shirwa, February (H. Barlow), and Mlanje, Nyasaland.

In coll. Janse from Victoria Falls, January 1918.

The type of *O. septiguttata* in coll. Richelmann is a dark mouse-grey colour, with the antemedian line of the forewing above very indistinct; on forewing, above, faint vestiges of two reddish patches, on hindwing of one; tarsi, antenna, and genitalia (as far as visible in the specimen) as in other *incana*-♂♂.

Genus: **Carnegia** Holland (1896).—Typus: *mirabilis*.

Holocera ?, Aurivillius, *Ent. Tidskr.* xvi. p. 120 (1895).
Carnegia Holland, *Ent. News*, vii. p. 138 (1896) (type: *mirabilis*).
Goodia, Aurivillius, *l.c.* xx. p. 247 (1899) ("*mirabilis*" the ♀ of some species of *Goodia*).
Carnegia, Aurivillius, *Arkiv Zool.* ii. 4. p. 21 (1904); Strand, *Iris*, xxiv. p. 187 (1910) (partim).

♂♀. Differs from *Orthogonioptilum* in the hindwing of the ♂ (as well as ♀) being produced inward into an anal lobe, and in the terminal margin of the ♀ being bisinuate in the forewing and irregularly scalloped in the hindwing. In ♂, moreover, vein SC^2 of hindwing more proximal than in the ♂♂ of *Orthogonioptilum*.

Hab. West Africa.——One species.

1. **Carnegia mirabilis** Auriv. (1895).

♀. *Holocera* ? *mirabilis* Aurivillius, *Ent. Tidskr.* xvi. p. 120. no. 38 (1895) (Nyong River, Camerun.—Mus. Hamburg).
♀. *Carnegia mirabilis* Holland, *Ent. News*, vii. p. 138. p. 134. tab. 6 (1896) (Efulen, Camerun; ♀, neuration and pupa figured).
♂. *Goodia impar* Aurivillius, *l.c.* xx. p. 246. no. 73. fig. 15 (1899) (Nyongwe River, Camerun; ♂ of *mirabilis* ?—Mus. Hamburg).
♂. *Orthogonioptilum impar*, Strand, *Iris*, xxiv. p. 188 (1910).
♀. *Carnegia mirabilis*, Schultze, *Arch. Naturg.* lxxx. A. 1. p. 162. no. 25*c* (1914) (Adamaua, ♀; larva ?).

♂. There can hardly be any doubt that *C. impar* is the ♂ of *C. mirabilis*. Chocolate, sometimes brighter, sometimes darker, apical third of forewing irregularly covered with grey scaling; antemedian and postdiscal lines each bordered with a thin grey line both on the proximal and distal sides. On *underside* the forewing with an ochraceous discocellular patch and a smaller and paler costal subapical spot. Collar grey. The anal lobe of the hindwing is more directed inward than in the figure given by Aurivillius.

On forewing 4 to 6, on hindwing 3 to 5 vitreous or semivitreous dots.

Antenna with 17 to 20 segments quadripectinate and 13 to 16 non-pectinate.

♀. It is significant that, as in the ♂, the upper vitreous spots of the forewing are the largest (they are very much larger in ♀ than in ♂), and that the grey outer border of the antemedian line curves distad in middle, as in ♂. Termen of forewing sinuate below apex and below R^3 and M^1. Antenna with 19 segments quadripectinate and 14 simple, apical branches of anterior (= inner side) only one-fourth shorter than proximal branches.

Genitalia: ♂. Of the *Orthogonioptilum* type. Eighth tergite (VIII. t., text-fig. 156) produced into a smooth, dorsally convex process which is rounded at the apex. Eighth sternite with obtuse, short, broad, triangular median lobe. Tenth tergite (X. t.) a transverse sclerite, which is broadly sinuate in middle and bears at each side at the base a large denticulate tubercle which projects from beneath the eighth tergite (cf. text-figs. 156, 157). Tenth sternite (X. st.) a low ridge.

Clasper, viewed from ventral side, narrowed distad, dilated at apex, which is subspathulate and bears a long spiniform tooth at the ventral margin, the tooth pointing distad (text-fig. 158). On the inner surface (text-fig. 159) the clasper is divided by a longitudinal channel, which starts from before the centre and ends at the apex, a second channel running along the ventral margin from the base of the clasper to the base of the apical tooth. Penis-funnel (F) open dorsally, subcarinate ventrally, the apical margin produced into a lobe dorso-laterally.——♀. Genitalia not examined.

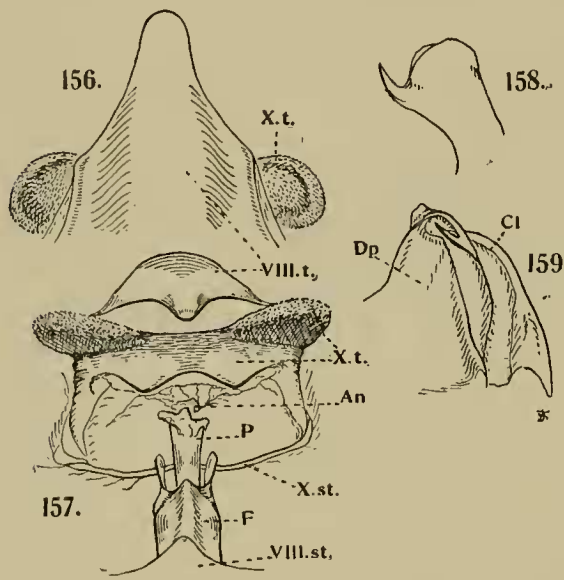


FIG. 156.—*Carnegia mirabilis* ♂; eighth tergite, dorsal aspect.
FIG. 157.—*Carnegia mirabilis* ♂; genitalia, ventral aspect, claspers removed.
FIG. 158.—*Carnegia mirabilis* ♂; apex of clasper, externo-lateral aspect.
FIG. 159.—*Carnegia mirabilis* ♂; clasper, from inner side.

Early stages: Schultze, *l.c.*, records a larva which "possibly belongs to this species." Similar to a *Ludia* larva, much flatter. Conspicuously emerald-green; spines and long hairs light green. A small number on *Anona senegalensis*. Pupa figured by Holland, *l.c.*, but structure of cremaster not indicated (with hooks as in *Goodia*, or without as in *Holocera* and *Ludia*?). Cocoon similar to that of *Ludia*.

Hab. West Africa: Sierra Leone to Gabun, probably farther south.

In Mus. Tring 3 ♂♂ from Sierra Leone (Major Bainbridge); Wassaw district, 45 miles inland from Sekondi, Gold Coast.

In Mus. Brit. 1 ♂ from between coast and Kumasi, Gold Coast (C. H. McDowall).

In Mus. J. J. Joicey 1 ♂ from French Gabun.

In Mus. Hamburg 1 pair from Nyong River and Nyongwe River, Camerun.

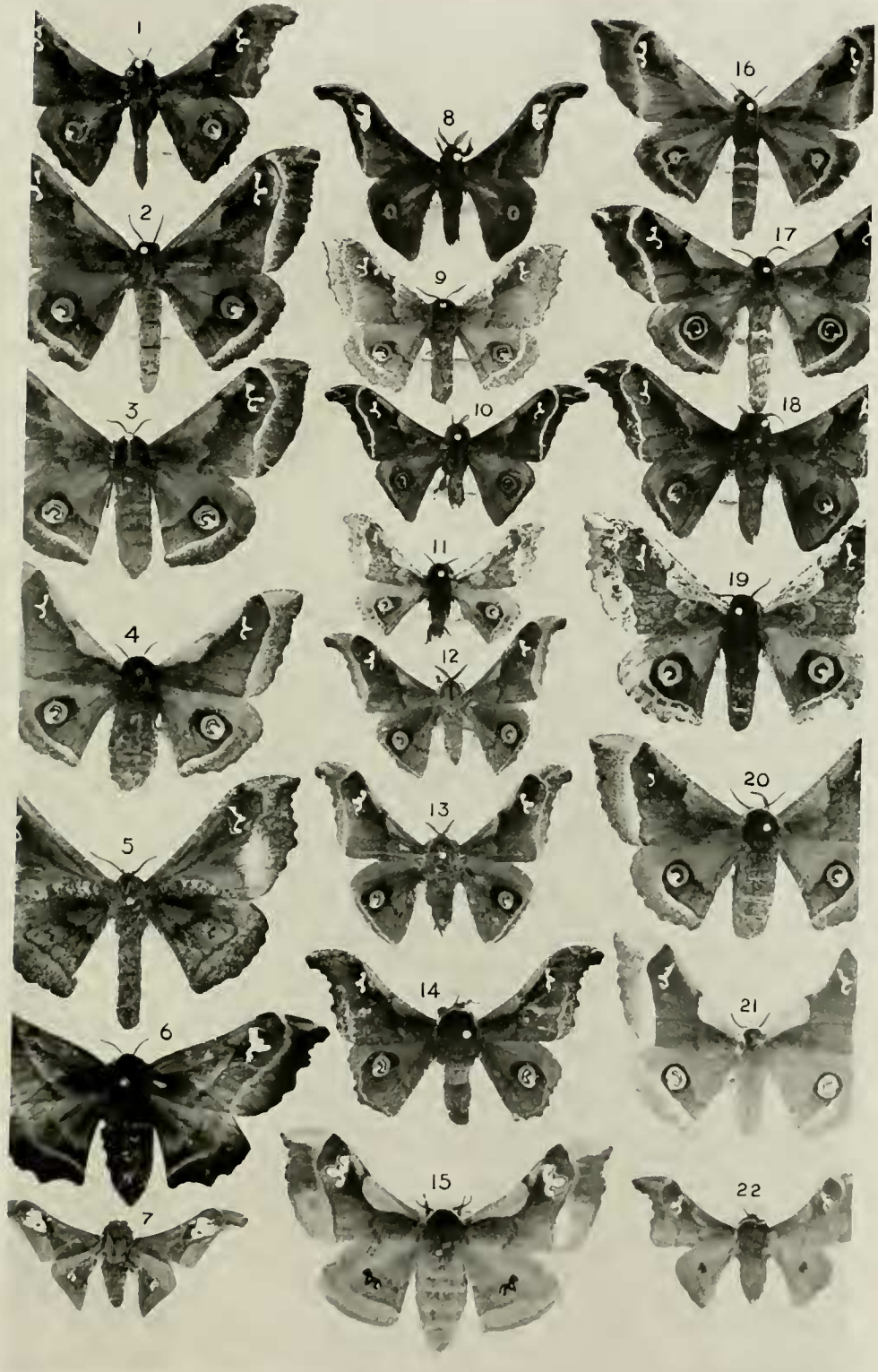
In coll. Holland 1 ♀ from Efulen, Camerun.

In coll. Arnold Schultze 1 ♀ from Adamaua, Camerun.

EXPLANATION OF PLATES I AND II (Lep.).

Plate I.

Plate II.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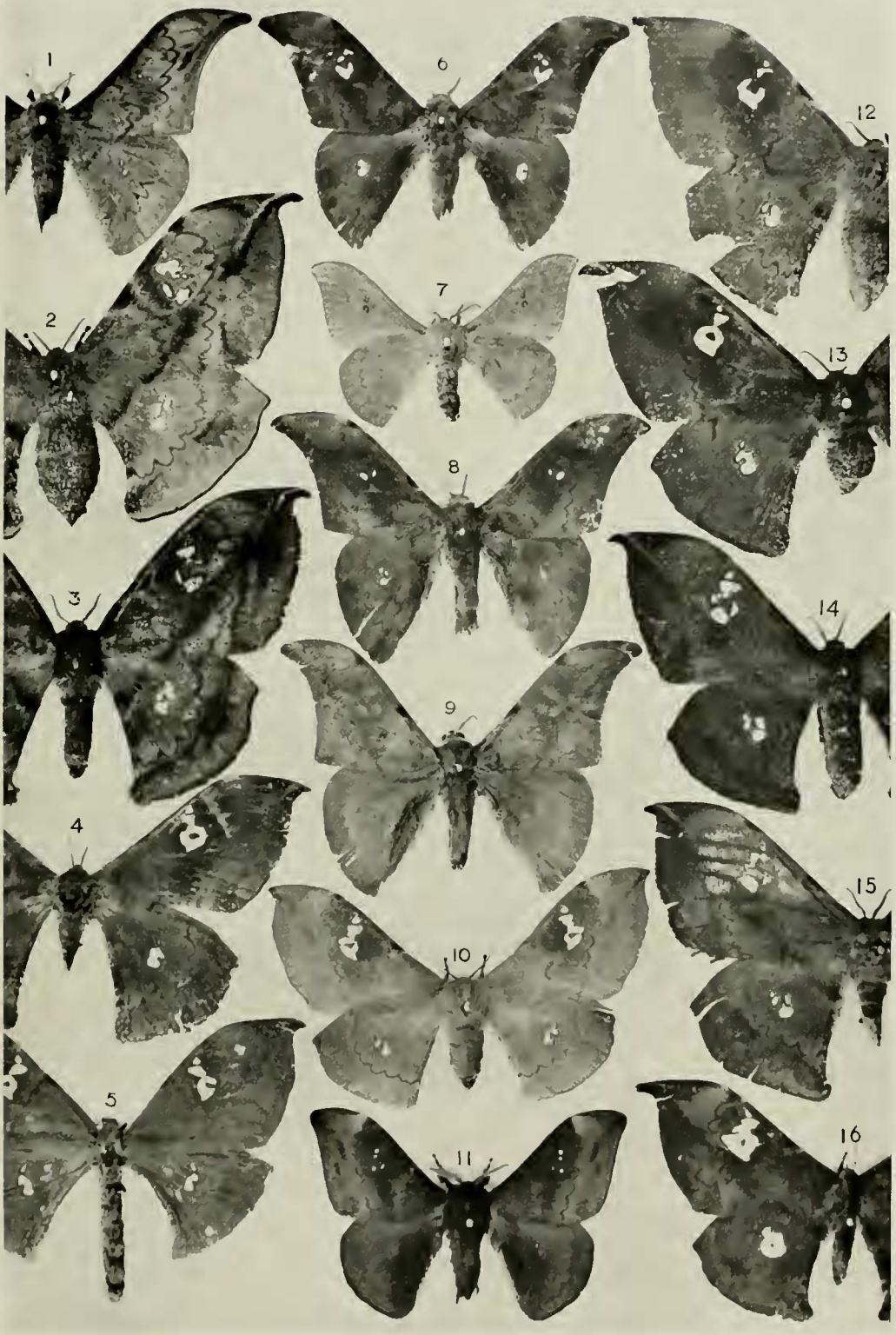
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